Municipal Engineering; Paper No. 1.*

BOSTON, MASSACHUSETTS.

(Continued from page 179.)

Cleaning of Catch-Basins.—By one of these unaccountable divisions of labor which will creep into the management of municipal affairs, the catch-basins, belonging to both the old and the improved sewerage systems, and which are built by the Superintendent of Streets, are cleaned by the Health Department.

The wagons used in removing the contents of catch-basins, which are cleaned as often as required, are similar in all respects to those already described in connection with the removal of "swill." Three men go with each wagon, and in working one man fills the catch-basin bucket (Plate 33, Fig. 1) at the bottom of the basin, another hoists the full bucket by the hooked pole (Fig. 2) and the third empties the bucket into the wagon. The

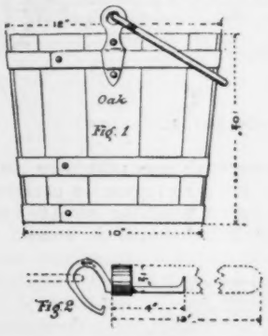

Plate 33.—Catch-basin bucket and Hook.

material removed is absolutely worthless, and is hauled to some one of the city dumps and at once covered with ashes.

In the year 1884-85, fifty-two men and seventeen wagons were employed in this service, about 28,000 cubic yards of dirt were removed and the expenditure was $14,906.53. There are about 6,000 of these catch-basins, many of them, however, belonging to hotels and other buildings.

Cleaning of Vaults.—An approximate estimate made by the Water Board for the Board of Health, in March, 1885, puts the number of privy-vaults in Boston at 11,491. This estimate includes the whole area of the present corporation; in the city proper there are still 2,874 of these vaults and in South Boston 2,082.

In the early part of 1885 the Massachusetts Legislature passed an act requiring that every building situated on a street in which there was a sewer should have water-closets of proper design put into them, and that the existing privy-vaults should be cleaned and filled with earth. Under this act the Board of Health have been issuing notices of discontinuance, and between July 1 and November 15, 1885, 561 of these vaults had been closed. The Board is acting vigorously in the matter and hopes to thus remove entirely one of the most dangerous class of nuisances with which it has to deal.

Existing vaults are cleaned by a contractor, who, under the direction and control of the Board of Health, has the monopoly of this work in the city. The present contract was made on January 1, 1884, with representatives of the Otis Odorless Excavator Co., to continue for three years from that date under the following terms and conditions: The contractor is to exercise the exclusive right for the period named of removing all the contents of vaults and other receptacles of night-soil in the city of Boston. The city is to receive and forward all applications for cleaning, and the contractor may demand of and receive from the owner or lessee of the premises, for his services, the sum of five dollars ($5.00) for every load of 80 cubic feet removed; and if the vault contains less than that amount the price to be paid is still the same as for 80 cubic feet. The contractor can demand a deposit of money from the citizen to secure his fee. All receptacles used by the contractor in his work must be air-tight and odorless, and the whole operation must be conducted in a cleanly and orderly manner.

The cleaning of vaults is now carried on entirely by daylight and without any offense whatever. The charcoal furnace formerly used in connection with the air-pump on the movable tank to burn the gases, is now superseded by a chemical process by which these gases are passed through a patented compound, of which carbolic acid is the base. The furnaces caused dangerous explosions at various times. The "excavators" used in Boston are practically the same as those found in all our larger cities; they are built, we understand, under patents controlled by Keyser & Painter, of No. 44 Holiday street, Baltimore, Md. They are simply very strong, air-tight, cylindrical tanks mounted on wheels, with a capacity of about 80 cubic feet; this tank is connected with the vault to be cleaned by a substantial suction hose which can be carried anywhere within a horizontal range of 150 feet; an air-pump on the tank provides the vacuum that transfers the material from the vault to the tank. Stout barrels with lids fitting tight by screw-clamps and a gasket, are employed in handling the more solid matter.

When the tank of the "excavator" is filled, it is hauled to one of two dumping wharves devoted to this purpose, and there pumped or forced into air-tight tanks on collecting scows through a tight hose; these scows as often as filled, are towed out to deep water in the Bay and their contents pumped out, and the scow thoroughly washed before returning. Excepting in the thinly settled outlying districts, no house-holder is permitted to remove, or in any way dispose of the night-soil except by the appliances of the authorized contractor. The recent action of the Legislature has caused much more than the usual amount of night-soil to be removed in the past year. In 1884 the amount returned by the contractor was 513 "loads"; while from January 1st, to November 17, 1885, the official amount was 4,170 loads. Averaging the load at 70 cubic feet the aggregate quantity disposed of in 1884-85 was about 10,800 cubic yards.

Summary of the Health Department Expenses, etc.—According to the City Auditors Report for the year ending June 30, 1885, this department employed 510 men of all grades, and expended the total sum of $437,206.32. The principal items making up this total are given as follows:—

Labor in collecting dirt and ashes	$125,902.61
" " sweeping streets	97,280.10
" " collecting and removing offal	67,691.93
" " cleaning catch-basins	14,906.53
" other than above	25,942.24
Official pay-roll (including milk inspectors)	10,085.06
Grain, hay and straw at city stables	30,614.28
Horses purchased and exchanged	24,025.00
Stock, tools, paint, etc., bought	10,149.28
Contract for removing ashes, E. Boston	6,321.70
" " " offal " "	2,190.00
Extra teams collecting ashes	9,969.00

The receipts of the department were as follows:—

Sale of ashes	$10,895.01
Removing ashes from steam engines	3,264.75
Sale of street dirt and manure	1,466.74
Sale of house offal	36,420.52
Removing 12,975 prisoners	4,063.25
Milk inspectors licenses	1,081.50
Total	57,191.77

The item of "removal of prisoners" in the above is explained by the fact that this department provides vehicles for conveying prisoners to the city institutions in South Boston, and to the steamers running to those on Deer Island. The property in the care of this department at the four city stables (not including the real estate or buildings) is valued at $104,132.70 in the last return; this includes 235 horses valued at $200 each. The estimated value of the real estate and buildings is $95,500.

At the main city stable, or station, on Albany and Newton streets, there are a two-storied stable with accommodations for 117 horses; sheds for storing and cleaning wagons and tools; and blacksmith, wheelwright, paint and harness-makers' shops with all necessary tools. The horses are strong, handsome animals, as well groomed and cared for as those found in a gentleman's private stable. The tools are arranged in racks, or hung upon the walls on numbered pegs, and the user of a tool is made responsible for its return to its proper place. The city workmen here build the carts, offal-wagons and sweeping machines, make the harness used, and a number of the tools and appliances required by the department. The birch used for the street-sweepers brooms is bought in the bunch of birch twigs at seven cents per bunch, and three bunches make two good brooms. The revolving brooms of the street-sweepers are also refilled here, generally with "coir grass" costing (1885) 12 cents per pound; but experience has shown that rattan brooms, at thirty cents per pound, are much preferable and almost as cheap when the greater durability is considered. Every thing about these stables and city shops indicates system and discipline even in the smallest detail, and bears testimony to the wisdom of putting the department and its various subdivisions under the care of men who practically hold office during good behavior.

Telegraph and Telephone Lines.

Boston, like every other city, is overhung by miles of overhead telegraph wires and its streets are infested with poles. Of the aggregate miles of wires and number of poles no approximate estimate could be secured, for the very good reason that the companies owning them do not know.

Underground Wires.—The use of an underground system of wires is not compulsory, but the city ordinances contain provisions regulating work of this character. These regulations provide that permission must first be obtained by any company from the board of Aldermen; and the application and permit must define the time, manner and point of opening in the streets, and no company can be compelled to use the conduit of another company or to admit foreign wires into its conduit. Any telegraph or telephone company constructing a conduit must admit city wires free of charge; they must remove such conduit when required by the city, but can not remove it without permission, and they must file a bond of not less than $20,000 to indemnify the city in case of any damage resulting from its work.

The only party that has yet tested any underground system in Boston is the New England Telephone and Telegraph Co.; of the nearly 700 miles of wire within the city limits controlled by this company about 190 miles are underground. The original conduit used is shown in Plate 34, Fig. 1; in this design a number of 3-inch wrought-iron tubes, arranged as shown with at least a 3-inch space between tubes, was buried in a mass of concrete placed directly in a trench without casing of any kind. It was at first intended to use three cables in each tube, as at *A*, Fig. 1, but practice proved that while it was possible to put them in, no one cable could be

withdrawn separately, owing to the bends and twists in their length. A 2½-inch pipe with one cable in each is preferable. At convenient intervals the conduit opened into brick manholes from which the wires were conducted to subscribers; these manholes were intended to be absolutely water-tight from above as well as on the sides, but experience showed this to be practically impossible and the bottom was finally dished so that water leaking in could be pumped out. The wires passing through these conduits were insolated and enclosed in leaden cables. In the conduit last built, the use of concrete was discontinued, and for it was substituted a wooden box (Plate 34, Fig. 2), in which the cables were embedded in coarse sand; as the sand would permit the water to run off, this scheme was found to be less expensive and practically as efficient as the concrete con-

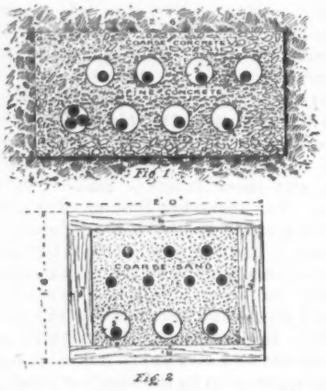

Plate 34.—Underground wire Conduits.

struction. As to the practical result of use, the underground telephone wires work well in the city, but for long-distance talking are not as good as wires over head; parties in Lowell, for instance, will preferable make a long detour to cut out the underground system when talking with Boston.

Telephone and Telegraph Service.—In conducting its general business, the N. E. Telegraph and Telephone Co., which is the only telephone company in the city, has introduced various features well worthy of mention. Its central office has about 2,000 subscribers, and the daily average of "calls" at present is about 11,000. This central office is new, and in removing to it a short time ago a decided change was made in the disposal of its wires; the city is now practically divided into a number of districts for telephone service, and all subscribers' wires in any one district are made to center upon some lofty and conve-

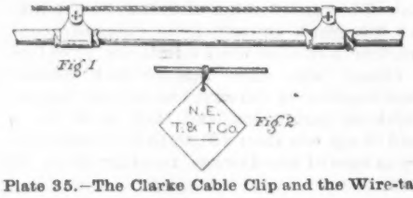

Plate 35.—The Clarke Cable Clip and the Wire-tag.

niently located building in the district; on this building the wires are connected to a cable and the latter only passes to the main office. This arrangement avoids the maze of single wires that would otherwise be inevitable over the main office.

The cables used are almost entirely leaden-covered, the canvas wrapped cable being the rare exception. Each cable contains from 35 to 100 insulated copper wires, and is supported at intervals of about 2 feet, in its flight across streets and buildings, by a galvanized wire rope of a diameter dependent upon the size of the cable and the clear span. The connection between the cable and the wire rope is made by the Clark Metallic Clip (Plate 35, Fig. 1), which has been found very satisfactory for the purpose intended. It is interesting to state in this connection that this clip was originally made of sheet brass; but accident disclosed the fact, just in time to avoid what might have been a serious mishap, that there was a destructive galvanic action taking place between the leaden cable and the copper in the clip, and that the clip was eaten away to the merest shell. These clips are now made of galvanized iron or zinc, and a strip of canvas is put around the cable at the connecting point, which also prevents slip.

The law in effect in Boston requires that all wires passing over a building must be elevated sufficiently to give from 7 to 10 feet head room to any one having business on the roof. And by an act of the Massachusetts Legislature of January 1, 1885, all wires and fixtures must be plainly marked at all accessable points by a small metallic tag, (Plate 35, Fig. 2), stamped with the name of the company to which it belongs. The purpose of this provision is to, among other things, enable the householder to fix responsibility for any damage to his property by the wires or their fastenings, where more than one pass over his house. The same law also imposes a penalty of not less than $50 for attaching wires to a building without the permission of the owner.

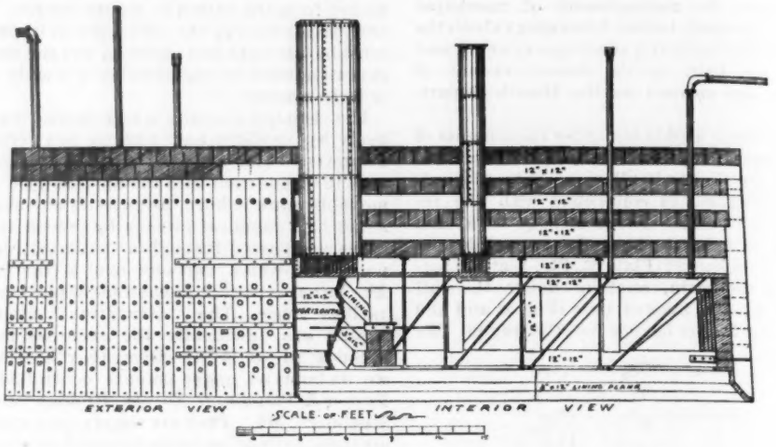

Plate 1.—Elevation of Pivot Caisson. (*See page* 195.

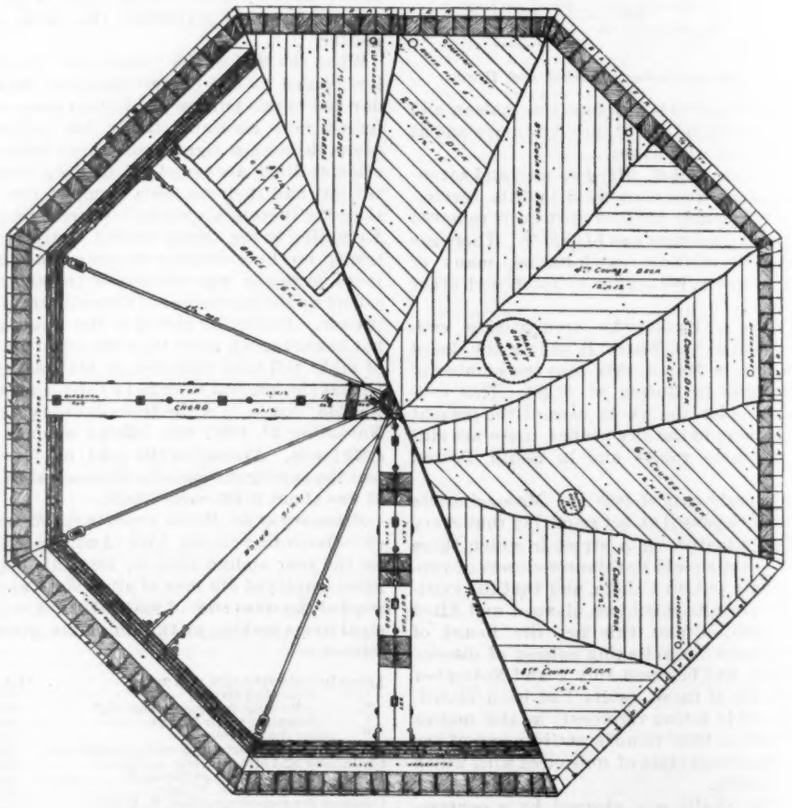

Plate 2.—Plan of Caisson, Showing Roof Courses. (*See page* 196.)

The N. E. Telephone & Telegraph Company uniforms all its line men so that they may be recognized by house holder, and has found it to pay to rent the roof-right from owners and to otherwise treat them in an equitable manner.

(TO BE CONTINUED.)

The Schuylkill B. & O. Bridge.—The Pivot Pier Foundation.

Written for ENGINEERING NEWS.

BY COL. WILLIAM M. PATTON, ENGINEER IN CHARGE.

(*Continued from page 85.*)

The strength and suitable character of the caissons used in the foundations of the Susquehanna Bridge of the Baltimore and Ohio R. R. Co., having been there fully established, it was natural to adopt the same general construction in the foundations for the Schuylkill River crossing of the East Side Branch of the B. & O. in Philadelphia.

The conditions of the site called for four pneumatic caisson foundations and one ordinary coffer-dam. Two of these were rectangular, 64 by 22 feet, one a pivot pier caisson, 47 feet in diameter, and one was an abutment pier caisson 44 by 40 feet.

The construction and sinking of the Pivot pier foundation will form the subject of this article. The octagonal form was adopted for this caisson as requiring the minimum of material and labor and as being the strongest. The contract was awarded to Gen. Wm. Sooy Smith & Son on July 7, 1885, and on July 21 the framing of the pivot foundation was commenced.

The height of this caisson (see Plates 1 and 2) was 16 feet 3 inches; pitch of working chamber 8 feet 3 inches, and thickness of roof 8 feet. The batter all round was $\frac{3}{16}$-in. to one foot; diameter of inscribed circle at top was 47 feet and at bottom 48.67 feet. The circumscribing octagon had sides of 19.47 and 20.15 feet, top and bottom respectively. A solid wall of 12 by 12-in. timbers 6 feet high was first built, and on the inside of this were spiked three courses of 3-in. plank placed diagonally, and one course of same plank vertically for convenience in caulking. On the outside was a solid wall of 12 by 14 in. sticks 14 feet long projecting 2 feet below and 6 feet above the horizontal timbers mentioned. Two strong trusses were framed at right angles to each other to support and stiffen the roof; and, as constructed, at the same time to act as strut and tie braces for four of the eight sides of the working chambers. The remaining four sides were supported by strong braces crossing at the center.

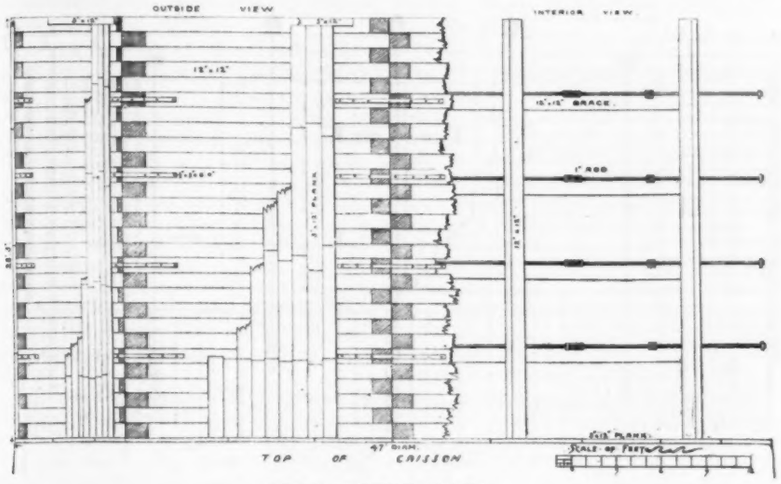

Plate 3.—Elevation of Crib.

Iron rods were then passed through the walls of the chamber at the angles and attached to an iron ring or collar at the center of the caisson (see Plate 2). The first roof course was then put on and the caisson was ready to be launched, after the first sections of the main, supply and discharge pipes had been put into position. The launching was successfully accomplished on August 31st, the launching weight being 452,250 pounds. The water being deep, no bottom was put into the caisson, and as a consequence it floated with the entire working chamber under water. The roof was put in place rapidly, the successive courses of timber being bedded in cement mortar with the vertical joints well grouted, and the whole thoroughly bolted by drift and screw-bolts. The first three courses of the roof rested on the plank and square timber walls inside the outer verticals; the next three courses were supported on shoulders cut into the verticals, and the two top courses extended from out to out resting on the tops of the verticals. A course of 3-inch plank was then placed on the roof and thoroughly caulked.

On September 16th the caisson was floated into position, and the crib (Plates 3 and 4) was then commenced. On September 19th concreting began, and on September 25th the air connection was made. The sinking progressed regularly until October 2nd, when in sinking 3 feet a "blow-out" occurred, and the caisson settled rapidly 4 feet more, and only stopped when a sufficient bearing on the mud was obtained to counteract the superincumbent weight. This accident broke the pipes and connections, drove the workmen up the shaft and practically stopped the work for several days. At the time the weight of timber, iron and concrete was 2,736,000 pounds, and the cutting-edge was 30.19 feet below low-water, or 16 feet in the mud. The air pressure was 14 pounds.

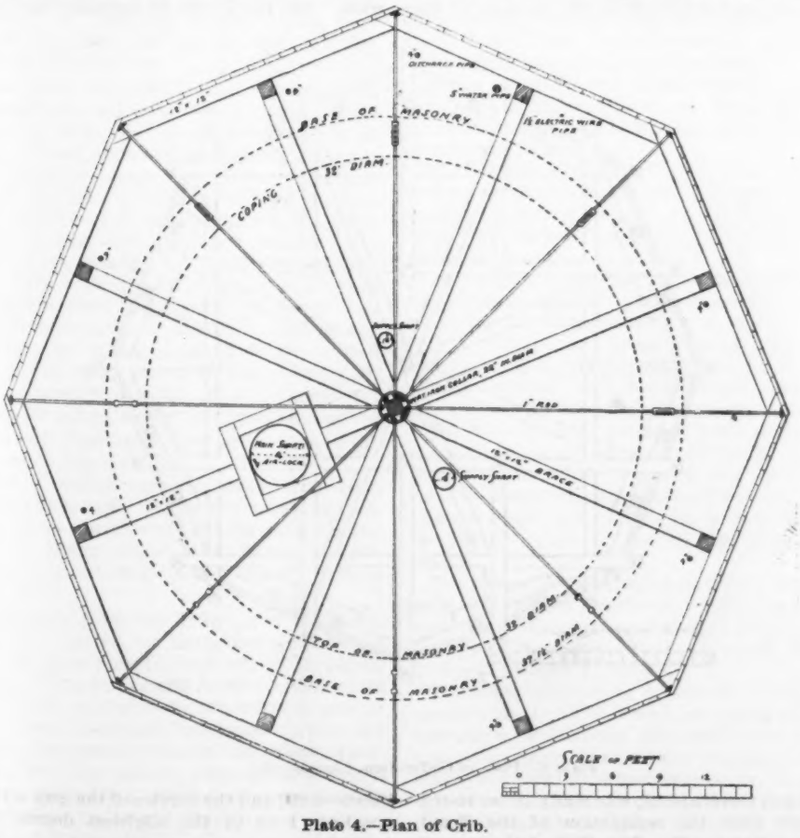

Plate 4.—Plan of Crib.

The crib (Plate 4) was also octagonal. A center post was first set up and from this, like the spokes of a wheel, radiated tiers of braces placed 5 feet apart vertically. Each brace abutted against the post at the center and a vertical timber placed in the middle of each side; the corners were tied by rods passing to a central collar.

The coffer dam (Plates 5 and 6) placed on the crib was braced in a similar manner, no rods, however, being used at the angles, as the pressure was entirely from without. The coffer-dam was held down by rods attached to eye-bolts in the crib (Plate 5), and passing through long tie timbers crossing the top. By disconnecting these rods the sides of the dam were easily removed.

No special difficulties were encountered in sinking this foundation as the material was uniform throughout, and of a stiff, compact, clayey nature, practically water and air-tight. The caisson reached rock on October 17, and after close examination it was stopped there and the sealing of the cutting-edge commenced and carried on progressively around the caisson; the greatest depth reached below the cutting-edge was about 9 feet. When the sealing was finished the interior was ex-

cavated, the rock surface bared and cleaned, and on October 26 the work of filling the caisson was commenced, finished November 3, and the laying of masonry commenced on the same day.

After the experience at the Susquehanna, it was found best to build in the pipes instead of attempting to remove them; their removal costing delay, and a leakage always followed. These pipes were filled up afterwards. As there was little sand or gravel the material was cut up with the water-jet and removed with the water-pump. The blowing out process was not resorted to at all.

The quantities of material used and excavated, depth sunk, etc., are given below.

Depth sunk below low-water	48.1 ft.
Depth to lowest point of rock	57.1 "
Timber in caisson, 241,239 ft. B. M.	
Timber in crib 81,926 " "	
Timber in cofferdam 32,707	
Total timber	355,872 ft. B. M.
Excavation in sinking caisson	113,306 cu. ft.
Concrete in crib	1,629 cu. yds.
Concrete in air-chamber	676 cu. yds.
Barrels of cement used	2,366
Yield per barrel of cement	.97 cu. yds.
(Large stones were bedded in mortar and estimated as concrete. The sand and cement were mixed by the Sooysmith & Co.'s patent mixer).	
Drift bolts used	24,954 lbs.
Screw bolts used 32,956 "	
Spikes bolts used 5,260 "	
Total Iron	63,184 lbs.
Iron used per 1000 ft., B. M. of timber	177 ⅛ lbs.
Average rate of sinking per day	1.07 ft.

CHILLED-CAST-IRON ARMOR.*

Why chilled cast-iron has been officially adopted by almost almost all countries of Continental Europe as an armor material. (Extracted from Appendix to a Report on New Armor Material in Europe made to the War Department in 1884.)

BY CAPT. W. H. BIXBY, U. S. ENGINEERS.

Before 1869, chilled cast-iron was only casually spoken of as armor material; in 1874 it was officially adopted by Prussia for the construction of all revolving forts and all casemated batteries, for either coast or land defence.

Other countries have followed the example of Prussia. Forts of this material have actually been constructed for Belgium and Austria; others have been ordered for Austria and Holland; still others are being negotiated for by France, Spain, Russia, Italy, China, Japan and South America.

Such decided action, especially of the continental powers of Europe, as to the introduction of chilled cast-iron as armor material, seemed to make it very desirable that American officers should know what these trials were and what results were obtained therefrom.

The first trials of chilled-cast-iron were those occurring at Tegel, from February 27th to December 16, 1869.

These trials were very interesting but not decisive; the manufacturer, the test commission and the War Department, all had different opinions as to the practical value of the results. However, these results were regarded as of sufficient importance to authorize the Prussian Government in ordering from the manufacturer, Mr. Gruson, of Magdeburg, a test-cupola suitable for inland defence, and a test-casemate battery suitable for coast defence. Moreover, the results of past and future trials were to be kept as secret as possible.

The new test-cupola was intended to afford a direct comparison between the resistance of equal weights of chilled cast-iron and rolled wrought-iron, and therefore the War Department ordered that the programme of trials, and the construction of the new cupola, should resemble as far as possible those of a wrought-iron turret previously tested at Tegel.

The resulting construction is here referred to as "the first *test-cupola*." It was tested at Tegel in March, 1873, and did not give satisfactory results as regards the cupola itself. The chilled iron glacis plates, however, resisted so well that their use was immediately and officially adopted by the Prussian Government; and orders were given for the construction of similar glacis plates for the two rolled wrought-iron turrets then in project for Dusseldorf.

The *test-casemate battery arranged for coast defence*, and ordered from Mr. Gruson by the Prussian Government, was ready to be tested shortly after the completion of the Tegal trial of March, 1873. The first of these casements was tested December 5, 1873, at *Buckau*. It was struck three times, at points which were all contained within a circle of six inches diameter by unloaded chilled cast-iron 11-inch shells, each weighing 512 to 517 pounds, fired by a charge of seventy-five pounds of prismatic powder from a gun placed at the close range of only 52 feet. Each shell produced the same effect as if fired with the service charge, eighty-eight pounds of prismatic powder, at a range of 2,460 feet; that is to say, its striking velocity was 1,263 feet, and its living force at impact was about 5,700 foot tons. In spite of the (at that time) enormous energy developed (167.0 foot tons per inch circumference of shell), the total effect of these three shots striking so close together, was to produce only a slight abrasion about one inch and a half deep, and three cracks, none of which were over sixteen hundredths of an inch wide. On the inside no splinters had been knocked off, and the service of the gun would not have been in the slightest degree deranged.

Notwithstanding the "non-satisfactory" results of the "first test cupola" of March, 1873, at Tegel, Mr. Gruson was convinced by an

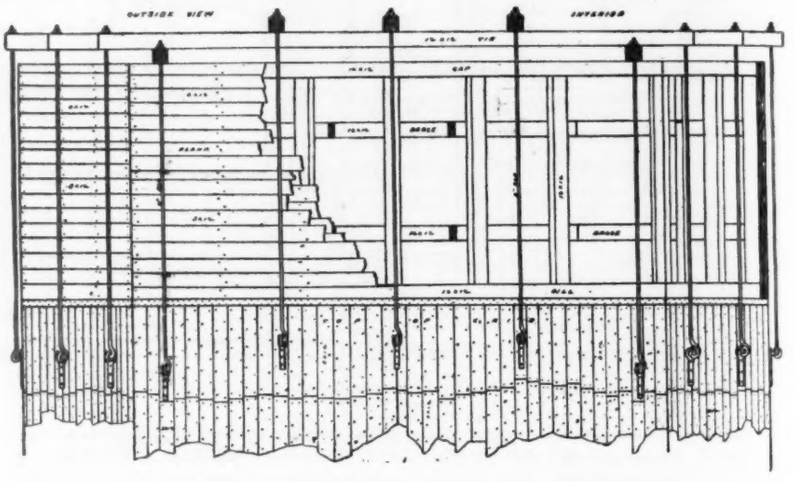

Plate 5.—Elevation of Coffer-dam and fastening bolts. (*See page* 195.)

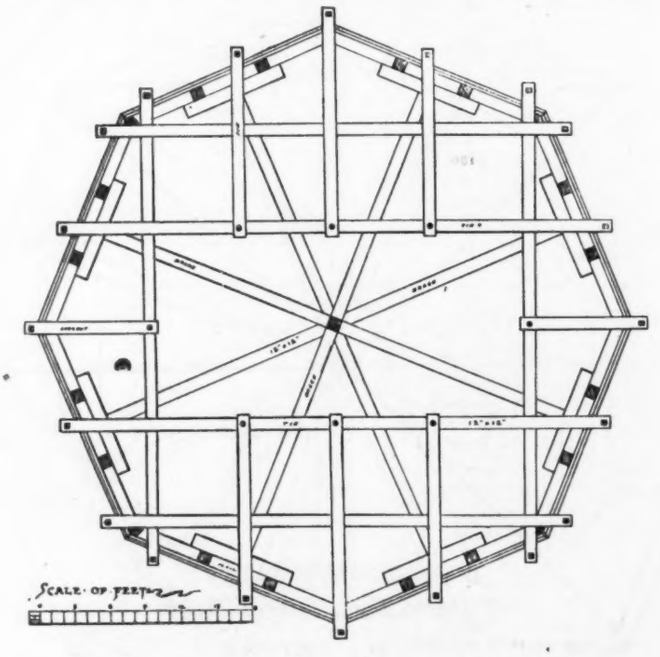

Plate 6.—Plan of Coffer-dam. (*See page* 195.)

* Published in the ENGINEERING NEWS by permission of the War Department.

eighteen year's experience in the manufacture of chilled cast-iron, that he had found the right material for iron armor; he therefore requested the Pussian Government to allow him a second trial. This request was met by the reply that they would gladly pay for the *experiments*, but that he must pay for the *cupola*; a condition that he readily assented to, because it left him perfectly free to construct his second cupola according to his own ideas of what was necessary to make such a cupola proof against the fire to which it should be subjected in actual warfare.

The "*second test cupola*," thus built in accordance with the ideas of the manufacturer, was ready for its tests early in the following year; and the trials actually took place at Tegel from May 7th to July 14, 1874. The result of these trials were exceedingly satisfactory to all concerned. The firing upon the *front embrasure plate* was carried on until the plate was on the point of being breached; at that moment the cupola was undoubtedly still in a defensive condition, although the plate had been struck by 193 of the (15-c. m.), 5.9-inch loaded long shell, seventy-five of the (15-c. m.) 5.9-inch chilled cast-iron shells, and twenty of the (17-c. m.) 6.7-inch chilled cast-iron shells.

The 5.9-inch long shells weighed about 64 pounds each; were fired from a hooped-gun at 492 feet range, using 9.2 pounds of prismatic powder; and struck with 1,200 feet velocity and 632-foot tons of living force.

The 5.9-inch chilled cast-iron shells weighed about 76 pounds each, were fired from a hooped-gun at 492 feet range, using 10.6 pounds of prismatic powder; and each struck with 1,148 feet velocity, and 700-foot tons of living force.

The 6.7-inch chilled cast-iron shells weighed about 120 pounds each; were fired from a marine hooped-gun at 492 feet range, using 20 pounds of prismatic powder; and each struck with 1,325 feet velocity, and a living force of 1,460 foot tons.

The cupola was still in defensive condition, and the front embrasure plate was not quite breached, after its exposed surface of 32 square feet of plate had been struck 288 times by projectiles whose total living force was 219,000 foot tons (an average of nine hits and 6,800 foot tons of living force per square foot).

The 193 long shells had not produced any effect worth alluding to; the 95 chilled cast-iron shells were the only ones that had been effective against the cupola. In every case the projectile, solid or hollow, chilled or not, shivered to pieces upon striking; and if loaded, the shell generally broke before its charge could be ignited. In no case did any projectile actually enter at all into the metal.

The *rear plate* was only fired at to test some apparent surface defects.

Eleven chilled cast-iron shells, fired from the 5.9-inch gun, under the same circumstances as above, and striking with 700-foot tons of living force each, produced two through-cracks without any other serious damages.

The *cover plate* was finally, and after considerable trouble, hit fairly five times by the 11-inch mortar shells, each of which struck with a living force equal to that which would have been produced by an 8.3-inch mortar shell fired from 8,200 feet range. These five mortar hits nearly breached the plate, breaking it into four pieces. (The construction of cover plates has since been considerably modified by the manufacturer).

The *left side plate* was tested only long enough to obtain a fair comparison between its strength, and that of the other side plates; the two side plates having been intentionally constructed with different degrees of hardness.

Twenty chilled cast-iron shells, fired from 5.9-inch gun, under the same circumstances as before, and striking each with 700-foot tons of living force, produced only the usual surface abrasions and one crack 4 inches long. A total of sixty-four of the 5.9-inch chilled cast-iron shells, each striking with 700-foot tons of living force, produced two through-cracks, thereby dividing the plate into four pieces, but did not succeed in knocking off any splinters upon the inside.

The firing against the *right side plate* was continued until the plate was breached, a result that was hastened a little by the intervening trials of the cover plate. Still the right side plate, in order to be breached had to be hit 134 times by the 5.9-inch chilled cast-iron shells, fired under the same circumstances as before, and striking each with 700 foot tons of living force.

During the first hundred shots, the only effect produced upon the inside was the formation of cracks, and the falling down of two small pieces of metal.

The results of this "second test-cupola" trial, were so satisfactory that the Prussian Government immediately decided that all revolving forts (cupolas or turrets) for inland defences should in the future be constructed with embrasure, side, rear and glacis plates of Gruson chilled cast-iron, but that the cover plates should still be made of rolled wrought-iron.

The question of the adoption of chilled cast-iron, as armor material for coast defence, was still unsettled. The results of the Buckau trials of December 5, 1873, upon the "first test-casemate" had left doubts in the minds of some of the commission. Instead of, as in December, 1873, trusting merely to the effect produced by two or three hits in one spot, they desired to know how the casemate would stand if hits from several heavy projectiles were distributed equally over its surface.

It was to settle this latter question, that the "*second test-casemate*" was constructed.

The trials took place at Buckau on July, 27th, and August 24, 1874.

The firing was continued until the splinters of the breaking projectiles had torn away and knocked down the heavy wrought-iron protection shields placed above and at the sides of the casemate.

The casemate front was hit nineteen times by unloaded chilled cast-iron shells, each weighing 512 to 517 pounds, and fired by a charge of 75 pounds prismatic powder from a gun placed at 52 feet range; each shell struck with a velocity of 1,263 feet, and with an average living force of 5,700 foot tons.

The first ten shots, produced three through-cracks, one other large surface crack, some outside surface splinters, and the ordinary surface abrasions, and knocked down one piece of metal (weighing nine pounds) from the interior edge of one of the through-cracks.

The through-cracks were less than 0.06-inch wide; the exterior splintered surface had an area of less than 4 square feet, and a depth of less than 2.7-inches except in one spot where its depth reached 5.1-inches.

The other nine shots produced very little change; the front plate had been cracked into four pieces, which were displaced to less than 0.28-inches from their proper positions; the holes, produced by the new splinters on the outside where less than 3.2-inches deep, and covered less than 5.3 square feet of surface; the last few shots knocked off some few splinters from the inside edge of the through cracks; but the casemate was still in excellent defensive condition.

These nineteen shots represented a total living force of 108,000 foot tons on 96 square feet of exposed surface, and had been very equally distributed all over the plate, so that every square foot of the surface might fairly be said to have resisted a living force of 1125 foot tons.

The commission were satisfied by the results of these last trials; they expressed their opinion that the casemate had stood more than double the demands of their programme, and was still defensible; and, also, that it had been subjected to a much severer test than would ever been required of a coast battery in actual warfare.

Experiments made upon the cover plate at the same trials, caused the definite adoption of chilled iron for cover plates of coast forts, and has prevented the chilled iron from being refused in the construction of cover plates for inland forts.

The second test-cupola *trials at Tegal* in May and July, 1874, combined with the first and second test-casemate trials at Buckau in December, 1873, and July and August, 1874, were sufficient to cause the Prussian Government to definitely and officially adopt chilled cast-iron as the only material to be used for the armor plate of both their inland and coast defences.

Since 1874, one turret (that at Dusseldorf) has been constructed in wrought-iron; but such construction was due to the fact that the iron contracts with the English manufacturers had been so far negotiated that it would have been hardly possible to have cancelled them.

With this sole exception, therefore, all revolving forts constructed in Prussia from 1874 to 1881, and all now in execution or in project are of Gruson chilled cast-iron.

As before stated, the Prussian Government in 1874, forbade all publicity as to further tests of chilled iron. This injunction remained strictly in force until 1877; Major Kuster, a member of the test commission of 1873 and 1874, was then allowed to publish the official reports on the 1873-74 trials in an article on "Chilled Cast Iron Armor," written by him and printed for private distribution amongst the Prussian Engineer officers.

This publication, No. 22 of the "*Mittheiungen des Ingenieur Comites*," was placed at the disposition of the writer, and he was fortunate enough during its translation to obtain the assistance of Captain Piorkowski, formerly of the Prussian Artillary, the officer who, during the "second test-cupola" trials was actually charged each day with the recording and the sketching of the effects of each shot. The original notes, reports, and sketches of Captain Piorkowski were also found, translated and revised; up to the present date (1886), the writer has been unable to find either Major Kuster's article, or Captain Piorkowski's original notes, printed in English.*

Recent experiments with projectiles have shown that the projectile's point may be so modified in shape as to increase its penetration; other experiments with successfully manufactured chilled *steel* shell seems to indicate in the penetration power of projectiles, another advance almost as important as that brought about by the substitution of chilled for ordinary cast-iron. Recent experiments in explosives have shown that at least one can be found suitable for use in shells, which though of more than the force of nitro-glycerine, shall be of moderate price and perfectly safe to handle.

Under such circumstances, the future of any soft metal armor plate, such as wrought-iron, seems very precarious—as it must be

*This translation in full is now in the hands of the War Department and Congress, awaiting their decision as to publication.

constructed strong enough to resist the living force of not only the penetrating projectile but also of its explosive charge.

On the other hand, the chilled cast-iron armor plate has never allowed any penetration of the striking projectile; not only is the projectile shivered to pieces, and a considerable part of its living force lost as regards the armor plate, but its interior explosive charge has no chance to produce, on the armor, anything but a mere surface effect, of little or no account.

It is believed that in chilled cast-iron, an armor-material has at last been found allowing, to-day, the easy and rapid construction of fortifications which shall be capable of resisting advantageously, and keeping out almost entirely, all projectiles that can be brought against them for many years to come."

New experiments are to be made by the Italian Government in April, 1886, at Spezzia, to see how a chilled cast-iron shield will resist the projectiles of the 100-ton gun.

(TO BE CONTINUED).

European Sewage and Garbage Removal.*

BY W. HOWARD WHITE, M. AM. SOC. C. E.

For sewage removal in Europe five methods are at present in use: 1. Dry removal. 2. Water carriage, simple. 3. Water carriage, with purification (precipitation) works. 4. Water carriage with filtration or irrigation. 5. Dry removal, and working up into saleable products. The first method is in most general use still. The second method, more or less introduced into all large cities, was brought about by covering in of water-courses and introduction of pressure water supply. Denser population and sluggish rivers led to use of third method, leading first to intercepting sewers, and then to purification. The latter is about to be adopted in London (recommended by Royal Commission, 1884, who declare the condition of the Thames below London unbearable). Experiments show that a month's sewage of the city is generally to be found floating between Barking and the river mouth. Precipitations is successfully practiced in Leeds and other cities, giving a clear effluent and a disposable, but non-saleable, manure. It is claimed that the effluent again decomposes if carried far in sluggish streams. The cost *per capita* in Leeds for purification is 22 cents per annum; for dry removal 24 cents per annum. If the whole population in sewered districts which now use sewers for slops used them also for excreta, cost *per capita* is estimated at 16 cents. This includes cost of purifying slops. Dry removal figure (24 cents) includes removal of ashes and garbage. No allowance is made for cost and maintenance of sewers, because these are needed any way for slops and storm water. Taking interest and cost of maintenance on these into account, total cost *per capita* per annum for storm water, sewage and slops, 45 cents.

Knostrop Works, at Leeds, consist of 12 settling basins, 60 by 100 feet, with pumps to raise sewage, and appliances for cutting out any basin for cleaning. Precipitation effected by mixing milk of lime with sewage. Sewage passes from tank to tank, over divisional walls, to prevent surface current. First five tanks cleaned every five days, sixth and seventh about once a week. Others very rarely. Deposit in tanks, when cleaned, averages: In No. 1, 21 inches deep; No. 2, 18 inches; No. 3, 10 inches; No. 4, 6 inches; No. 5, 5 inches; No. 6, 4 inches. In the last five, never over 1 inch. In the works now building at Frankfort-on-the-Main, sewage flows through three tanks used simultaneously, giving slower velocity, which if attained may be advantageous; but no precautions are taken against surface flow. Out of four tanks provided, one will always be in process of cleaning. By placing works some distance below the city, Mr. Lindley has been able to operate ordinarily without pumping, except for cleaning basins. He has thought it necessary to cover the basins with vaults, to prevent interference with cleaning by ice. This does not seem necessary. Precipitant to be used at Frankfort is aluminaferric. Acid in this is set free by reaction with alkalies in the sewage, and alumina remaining precipitates the solids by its affinity for organic substances. As alkalies in sewage are not sufficient to neutralize all the acid, milk of lime is added to render the whole action of alumina available. Where there is much acid in sewage this process is not practicable, because as much lime is needed as without the process. Advantages claimed: 1. Precipitation of impurities in solution as well as in suspension. 2. Effluent not so liable to after putrefaction. 3. Does not make so much sludge. 4. Less danger of escape of free lime.

Irrigation is used with great advantage for smaller towns. Best conditions: Towns lying high enough for natural drainage to irrigation farm, the latter high enough to be drained by 5 foot sub-soil drains; depth of drains determined by climate partly. Towns of Harrogate, Yorkshire, is a good example of irrigation. Has the above conditions, with slopes steep enough to give rapid circulation and rapid drainage. Population, 10,000. Sewage farm, 230 acres. Depth of drains, 4 feet (found too shallow). Effluent fairly good, except occasionally, in dry weather, when ground cracks. In our drier climate, with land equally sloping (1-14th to 1-16th), drains should not be less than 5 to 7 feet; with flatter land, shallower drains can be used, but more land is needed. Sewage arrives at sewage farm finely comminuted. Leaves no paper on surface of farm. When sewage was broken near town, ground in neighborhood was covered with paper. Authorities believe paper is ground up and dissolved in flowing one-half mile further to sewage farm. Appears more probable that it collects at points in the system, and that the flood that broke the sewer (storm water being partly carried in it) dislodged it.

Harrogate's experience shows the difficulty of using irrigation for cities over 100,000. Sewage farm becomes too large, requiring one acre for 50 to 100 people, with favorable Harrogate conditions, while for large cities the farms would have to be scattered about. Harrogate's farm, worked by city, and fairly remunerative, could be combined with poor farms in our towns of similar size. Favorable features in our climate: The ameliorating effect on ground of warmth of sewage in winter, and greater capacity for sewage in our dry summers. Modification of irrigation is filtration, proposed by Frankland in 1870. Land is chosen of a level character, with sandy or chalky soil, and thoroughly subdrained. Divided into four plats, upon which sewage stands successively six hours on each. Accepted minimum area, one acre per 1,000 people. Town of Kendal, Westmoreland, has purified sewage this way for ten years, with 850 people per acre, and effluent still good. Only coarse crops can be raised, and it seems only a question of limited time until soil becomes choked with sludge. Recommended for large places only, with preliminary precipitation, as by Royal Commission on Metropolitan Sewage Discharge (London) in 1884. Precipitation works proposed at Barking, discharging over filtration area and again into Thames. Cost of preparation of land for this plan $350 per acre. Land itself for London would cost $1,000 per acre. Cost *per capita* for filtration would be 5 cents; precipitation, as in Leeds, 16 cents; total, 21 cents per annum. Sewer for London can be extended to deep water of British Channel at annual cost *per capita* for construction, maintenance, and pumping out, 27 cents for population of 6,000,000. Cost of above outlet would cover one, with slight addition for the population of the Thames Valley, of 10,000,000. Cost per head would then be 20 cents, against at least 21 cents, as before, for filtration, requiring 10,000 acres for filter-beds alone. Recent experiments show advantage to fish culture of very dilute sewage, forming an argument for discharge of sewage into large bodies of water.

5. Method practiced on largest scale at Manchester, England, where urine and fæces partially deodorized with the house ashes are removed in pails to manufacturing depot, where they are converted into manure (along with the market garbage and dead animals) and into a variety of materials like soap, oil, candles, and mortar, all of which are used by the corporation, except mortar and manure, which find ready sale. Cost uncertain, somewhere between 24 cents and 37 cents *per capita* per annum. This includes also destruction of garbage and dead animals, which expense I have not been able to separate. Liernur separate pneumatic system cost, at its best, 22 cents per head per annum, exclusive of interest on plant and dust and garbage collection. More expensive than any other well-arranged system. Summing up: Dry carriage never economical or healthy. Combined wet carriage expedient for closely-built towns or quarters of same where slopes are not excessive. This supposes branches large enough to carry sewage and relieve streets of ordinary rains, and provision of overflows for intercepters to carry off all water not needed to dilute sewage to innocuous points. Separate system, applicable to steep streets or permanently rural neighborhoods, where storm water can be carried in gutters and natural water-courses.

As to disposal of sewage: The sea, or a body of fresh water as large as our great lakes, is a natural receptacle. To be discharged in a small town on such waters directly into the same, with provision for future interception and carriage away from town or out into the sea or lake to a safe distance. Where direct discharge is inadmissible, irrigation first resort, followed by precipitation and filtration. Berlin instance of large city using irrigation. Had, in 1884, 13,322 acres of sewage farms, with 1,200,000 population, and will probably be driven eventually to preliminary precipitation. Impossible to lay down hard and fast rules. Dantzic irrigates, though near the Baltic, because it was able to do so to great advantage. Providence declined to irrigate because it could purify sufficiently by precipitation to discharge into Narragansett Bay. New York will probably have to carry its sewage to sea eventually, and Chicago several miles out into the lake, at a point a good way from its water-taking inlet. Cities on the Mississippi will at a distant day have to resort to preliminary purification before discharging into the river.

European sewage depends too much on hand-cleaning. Sewers should clean themselves by normal flow, aided by drains or automatic flushing with ground or other water. No particle should enter a sewer which the minimum velocity in the same cannot carry. The main difficulty, where sewers are at all well proportioned, is with street washings. These should be kept out by proportioning catch-basins so as to drop all heavy matters

*From The Transactions of the American Society of Civil Engineers.

into the bottom by making the velocity through the basin at all times less than the least velocity ever occurring in the sewer, and intercepting floating matters by a diaphragm across the basin. The diaphragm to be removable, and bottom of basin to be formed by a pot, which could be lifted and dumped by a derrick on a wagon for the purpose of carrying off the washings. These should always be shut out of the sewers by grease traps at the houses. That fouling matters of a heavy or floating nature (not suspended) can be kept out of sewers, is shown by the Dantzig experience with syphons under the river, which have required no cleaning for 14 years, owing to the adoption of measures similar to the above. Overflows for storm water had better be long, narrow openings at the level in the sewer to which it is filled when enough diluted to overflow, allowing swimming matters to pass over as soon as this level is exceeded. Should be on the side of the sewer and not on its axis, so that the current would scour them and not tend to choke them.* Sewers large enough to enter can be made at small expenses large enough to carry all underground pipes and electric wires, and give room for making repairs and connections without tearing up the streets.

Ventilation in European systems is wrong in using house soil-pipes for ventilating sewers. American systems would be better if only one untrapped opening to open air were used, viz., a pipe carried up along the kitchen chimney. This would cause constant tendency of air in house drainage toward this pipe in case any leak occurred in the pipes—the air drawing into the pipes from house and up the kitchen chimney pipe—and would avoid freezing of water-pipes by circulation of cold air in soil pipes alongside them. Only chance of sewer gas getting into the house with such arrangement is stoppage of the kitchen chimney air-pipe at a time when house traps were empty, or by kitchen chimney being cold under the same circumstance, which almost never occurs, if ever, in an occupied house. Disposal of dead animals, garbage, dust, ashes and matters not suitable for the sewers, handled in the United States very crudely.

Destructors applied at various points in England and Holland accomplish this by fire at small cost. The two at Leeds consist of brickwork cells, with sloping hearth continued down into grates. All refuse is fed in a top, and works down gradually to the grate, where fire once started is kept up by the refuse. The hot gases pass off by side openings through the flues of a steam boiler, which runs a mortar mill. Latter grinds up clinker from the furnaces with lime, and makes first-class mortar. Old iron is sold as it comes out of ash-pit. All infected mattresses and clothing, and dead animals and condemned meat, are put into the destructor and consumed, without any fuel being used except the dry garbage and cinder left in the ashes from the houses. Burmantoft destructor burned up in year ending August 31st, 1884, 1,538 tons rubbish, 23,207 tons ash-pit rubbish, 45 beds, 96 mattresses, 58 pigs, 9 cows, 9 sheep, 4 quarters bad meat, the product of 100,000 people, at a net cost of £1,087 12s. 10d.

If the system was applied to New York, with a population of 1,500,000, where removal of same matter to deep water now costs $175,000 to $200,000 annually, the Leeds cost per thousand of $50 per annum would make $75,000 for New York. Destructors are placed in Leeds on less valuable property; rate of interest is about three-quarters of that here; cost of labor, two-thirds. Safe to estimate expense at double that of Leeds, or $150,000 for New York leaving still a margin, after absolutely destroying many things now only partially got rid of. It is alleged that the poorer population wash their ashes into sewers and burn the large cinder. Hence, not enough fuel collected from ash-bins to operate destructors. If so the practice should be stopped by inspection, and by obliging tenement owners to provide ash-spouts over which ashes could be sifted.

*Leeds borough engineer has devised overflow by letting off the surplus water under a float gate, which rises at the point of proper dilution of sewage, and at the same time shuts gate at main sewer, so that all the flow is eventually discharged through overflow as long as the flood continues. Makes it possible to proportion intercepters for sewage alone. Some doubt how satisfactorily such a float gate would work without very careful inspection.

The Swamps of the United States.

BY. N. S. SHALER.

The conditions which have determined the occupation of land in the United States differ widely from those which have controlled the settlement of most other countries. In other states there have been political or geographical limits which have greatly restrained the movements of population. In this country there has been, from the beginning to the present day, an abundance of good, readily subjugable land awaiting the settler. It is evident, however, that within this decade we pass from this old condition where excellent land was to be had for the asking. Before 1890 all such fields will have been occupied. There will be no more rich frontier lands ready to welcome the immigrant; therefore the tide of immigration will be turned upon the areas which have been passed in the swift westward movement of our population. These neglected districts are of great extent and very varied nature. They consist in part, of land which is somewhat less fertile than the best soils, but which in every other respect is fit for tillage. In larger part, however, these unoccupied districts, which constitute the land-reserves of the United States, afford soils which contain the elements required for the most profitable crops; but they are rendered infertile by an excess or a deficiency of water. In the arid but irrigable regions, and in the inundated or swamp lands, we have a very large tillable area which may be won to agriculture; and, when so won, these lands will afford resources of the utmost importance to the people.

In his report on the lands of the arid region of the United States, published in 1879, Major J. W. Powell has given an admirable account of those districts where the soils suffer from a deficiency of water, and in the preface to that report he notes the importance of the class of inundated lands; but so far, no detailed studies of the latter class of lands have been prepared. Recently, however, Major Powell has organized a division of the United States geological survey, which is charged with a careful inquiry into the geological history and physical conditions of the swamps and other inundated lands of the country.

A preliminary study of the field has shown the remarkable fact, that, owing to the abundance of cheap land which could be easily won to tillage, we have left untouched, in the region east of the Mississippi, districts of easily drained swamp-lands amounting to more than 50,000 square miles of area. These lands have the same nature as those which, in England and the states of northern Europe, were drained centuries ago, and now afford the most fertile fields of those countries. The inundated lands of the seaboard region of the United States, as well as the lands of the lower Mississippi, remain in the state in which they were when first seen by men, while the similar areas in England were long ago won to the state of the most fertile fields of that country.

Our American inundated lands are divisible into several classes, determined by the condition of their origin. Of these, the most important are the tide-water marshes the lacustrine swamps of the glaciated districts, the delta swamps of the Mississippi, and the class of wet lands or upland swamps where the marshy condition is due to the action of plants in retaining water under the surfaces of considerable districts. The formation of the sponge-like sphagnum-peat has been well described; but it is evident that a very large part of the southern swamps of the United States are essentially climbing bogs, though the retention of the moisture is due, not, as in the north, to the masses, but to the close-growing, flowering plants, principally to the common cane.

Preliminary studies of the great area of fresh-water marshes, extending from the mouth of the James River to the south of Albermarle Sound, show, that, in that district, this class of marshes covers an area of about 4,000 square miles. Throughout this district the peaty deposit is generally thin, not usually exceeding 4 feet in thickness, thus permitting the roots of the trees to force their way to the subsoil below the decaying vegetable matter.

The surface of the swamp, as well as the substratum on which it rests, is generally inclined towards the natural drainage of the country to the amount of two feet to the mile. The water is retained by the dense mat of stems, roots, and decaying fragments of plants, which are so closely interlaced that the friction in the interstices prevents the speedy outflow of the rainfall.

This class of marshes can be easily and cheaply drained, and, when so improved, they afford exceedingly rich soils. Along the outer margins of these vast morasses, some hundred thousand acres have been won to culture. These lands are remarkably fertile; and I am told that they often yield fifty bushels of shelled maize to the acre, and that they endure tillage for a period of many years without fertilizing.

It seems likely that of these easily reclaimed upland morasses, resembling the Dismal Swamp, there is a total area, in the southern states, of not less than 25,000 square miles. To these might be added the lands which are subject to serious inundations from rivers, which probably amount to something like 8,000 square miles.

In the northern states the area of improvable swamp-land is less extensive, but there is not a state in which they do not constitute an important part of the land reserve which the coming generation will be glad to use. It is easy to see, that, in these inundated lands of the United States, we may find fields which will give a larger return to the husbandman than those now tilled in any state of the union; and, furthermore, that with the rapid increase of our population, it is none too soon for us to be considering the aspects of this portion of our domain. It is clear that the national survey can, by a proper study of these swamp-districts of the country, so determine their condition as to prepare the way for the engineer. The aim will be to ascertain their extent, the conditions determining their value for tillage and the best method of approaching the economic questions which they present. Even where these swamps may be unprofitable for agricultural use, it may often be found that they are admirably adapted for timber-culture. The juniper (Cupressus thyoides) and the bald cypress (Taxodium disticum) are particularly suited to this form of forest-culture.

The scientific aspects of the American swamps, their relation to the changes of level of the continent, the ways in which their deposits were accumulated, cannot be considered in this place. My aim at present is to call attention to the great economic importance of this field of inquiry.—*Science.*

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THE Senate Select Committee on Ordnance and War Ships says that the 2,000 guns of all calibres in our forts and arsenals are of nine classes, and require thirty-three kinds of ammunition; they are only available against vessels of light armor and draught.

Of naval guns there are twenty-two classes, requiring thirty kinds of ammunition; and all, except twenty-four modern steel rifles, are of a type now abandoned by other first-class nations

Two dozen guns are a slim armament for our thousands of miles of sea-coast and even our antiquated navy. It is high time that we made some active movement in the direction of reform in this respect.

A NEW mode of distributing mechanical power is in use in Paris, viz.: by rarified air. By means of a central engine a vacuum of ten to twelve pounds is produced in a large steel tank which is connected by mains and service pipes to small motors, either in small factories or in the workmens' own quarters. Rarified air is held to be better than compressed, as it is free from the production of cold. An economical and easily managed power that can be distributed through a city or manufacturing town, so as to admit of what is technically known as cottage manufacturing, would be of great use.

MISS MARIA MITCHELL, the professor of astronomy at Vassar College, thinks that "surveying would be a healthful and pleasant pursuit for women," especially "as surveying is done mainly in pleasant weather."

With all due respect to the worth and wisdom of Miss Mitchell, we fear that her practical experience in the use of the Jacob's staff and surveyor's chain under normal conditions is limited. Doubtless to a Vassar girl all things are possible; but we can better imagine than describe the state of mind of the Vassar surveyor who first aspires to the every-day duty of the professional. She will find, among other things, that the ungallant sun will not always shine upon her labors; that mud will stick to her dainty boots, and that briars will lovingly entwine themselves about her back-hair. And, then, how about the horrid cows? Certainly, her lot will not be a happy one.

If the Vassar girl *will* link her fate with those "who engineers would be," we earnestly advise her to practice in the church chancel, rather than in a ploughed field or on the mountain side. She will find the first much more "healthful and pleasant."

Speaking of Vassar reminds us of the odd mistake made by the jury of award at a late County Fair in that neighborhood. According to a wicked contemporary, the girls sent in an exhibit of college-made sponge-cake, but unfortunately omitted to label it. The jury gave it honorable mention as a "new variety of paving-material," and testified to its fitness as "affording a good foothold, not likely to become slippery and as being practically indestructible."

THE sweeping denunciation of English bridge practice in the Colonies, as contained in the letters, elsewhere given, of Professor Kernot, himself an Englishman, are worthy of attention on both sides of the Atlantic. We doubtless have many weak highway bridges that would not stand criticism much better than some of those referred to in Professor Kernot's letters; but we do not *now* build bridges under such specifications as given for one "just completed" at Melbourne; nor do we think any American bridge builders would be guilty of sticking into his truss an entire set of diagonals which might as well be made of lath for all the work they can do.

It seems strange that in this progressive age, the usually alert Englishman does not for once set aside his prejudices and conservative notions, and satisfy himself by fairly conducted tests of the comparative merits of the high and low girder, pin *vs.* rivet connections and the other varying points of practice. We have no doubt of the results as far as the behavior of the test bridges would be concerned, and John Bull would get a much stronger bridge for the same money.

Still, as long as the Colonies will buy bridges and locomotives from America, we do not know that we have any special interest in improving the English home practice. Our mission should be to teach other nations that we make the best bridges and make them for the least money.

The reason for the continued stability for years of these notoriously faulty bridges, which puzzles Professor Kernot, can be, among other things, ascribed to "innate cussedness" or "sheer force of habit," as it was once put to us by an engineer.

Since writing the above we find that our English contemporaries, *The Engineer* and *Engineering* both devote space in their last issues to the subject of American bridge-building. But the two journals discuss the question with a difference; a correspondent of *The Engineer* writes an article on American Bridge Design, based on the late work of Prof. Waddell, and gives considerable space to an effort to pick flaws in his theory and practice; he admits at the start, however, that he has no very intimate knowledge of American structures. *Engineering*, on the other hand, reprints with its illustrations Mr. C. C. Schneider's paper on the Niagara cantilever bridge, read lately before the Am. Soc. of Civil Engineers. And a London correspondent writes a letter in the same issue on the question of American and English Bridge Construction, in which he admits the superiority of the former type. The writer further says that the main safeguard to English bridge-builders lies in the fact that Colonial and Indian contracts, as a rule, are let by companies whose headquarters and engineers are in London; and Continental and American firms cannot therefore compete. He remarks that if this was not the case, the Hawkesbury competition is likely to repeat itself.

The correspondent says that the whole system by which English contractors are kept in leading strings by engineers in Westminster, must be modified before they can produce as cheaply and well as others. The prevailing system leads to extravagance in design and waste in construction. He concludes by asking, "When will any engineer in Westminster have the courage to submit for tender the particulars of his bridge, as to span, load, loading gauge, permissible stresses, etc., and ask for designs with stress diagrams, etc.?" If this were done, he thinks the wholesome competion would improve English bridges, and soon bring the price per span to the American level, and that the Westminster engineers "could get quite as much bridge practice by acting as consulting engineers to various firms of bridge-builders, as they now do in drawing over and over again the same kind of bridge, always with a difference and rarely with an improvement."

The advice of the correspondent of *Engineering* is sensible, and accords with our own advice of honestly comparing all methods and selecting the best both from a point of strength and economy of material and labor.

The New York Times offsets the boast of a certain narrow-gauge Colorado railroad, that one mile of its line cost $150,000, by pointing with pride to the three miles of Broadway Railroad which represents $5,000,000.

The engineering difficulties overcome in the construction of this latter road are graphically depicted, from its start at or near the sea-level at Bowling Green, through the Canal St. Cañon to the giddy summit of 60 feet elevation at Union Square; the skillful manner in which the engineer has rounded the Lincoln Monument by curves, which would paralyze the sharpest twists on the Colorado line, is also fully set forth.

Our contemporary, however, omits altogether any mention of the pre-eminent skill displayed in the location of the intricate spirals and tunnels by which the Sharp engineer of the Broadway line bored through the Aldermanic Spur of the City Hall Range.

WE are indebted to Mr. Geo. H. Cook, State Geologist of New Jersey, for the following additional sheets of the State Map of New Jersey;—No. 1, Kittatinny Valley and Mountain; No. 9, Monmouth Shore; No. 13, vicinity of Barnegat Bay; No. 17, Peninsula of Cape May.

We have before spoken of the exceeding care with which these maps are made and the very handsome manner in which they are published. The present sheets are no exception to the rule, and when the seven atlas sheets yet needed to complete the map are finished, New Jersey will possess the most complete set of topographical and geological maps in the country; at least we know of no other State which is doing the same excellent work in this direction.

An engineering contemporary says that the steam road roller is regarded by the most eminent engineers of this country and Europe as an imperative necessity for the maintenance of Belgian Block pavements, among others. What would be regarded as imperatively necessary for the maintenance of the steam road roller and its driver's spinal column after a lengthy tour on Belgian Block pavements, is a question that might present some interest.

We reprint this week a valuable contribution to *Science*, by Mr. N. S. Shaler, on the subject of the swamp lands of the United States and their increasing value agriculturally. The paper is a timely one; the reclamation of hitherto valueless lands in some of our western states is already assuming immense proportions; the promise of the future is big with possibilities, and the people most interested are the property owners, engineers, contractors, manufacturers of improved dredging machinery and makers of drain tile, while the general public have also reason for being much interested in these enterprises. We have read of a vast drainage scheme of the Russian Government, now in progress; we have been familiar for years with the benefits to English agriculture of the great drainage operations of Lincolnshire and neighboring counties, and in these columns we have recently described some very large reclamation schemes in the State of Illinois. Many thousands of square miles of this country will be surveyed within the next ten years with a view to reclamation, and the services of engineers and contractors will be in demand. Increasing competition and the impatience of investors will necessitate the employment of the most effective machinery for accomplishing the greatest amount of work in the smallest period of time; and skilful engineering will also be a weighty factor in the race. One firm at least in the country has foreseen the possibilities of this department of engineering, and has already obtained an enviable prominence in furnishing machinery for excavating large drainage canals in the west.

British Freight Rates.

There is, at present, a good deal of excitement in England about freight rates, as there has been no reduction in transportation charges notwithstanding the great industrial and agricultural distress there; competition, as was shown in a late issue, not producing cheaper rates but an increased number of services. So Englishmen are wondering why with their costly roads ($202,000 against $61,000 per mile here) the charges per ton mile should be about twice as much there as here, when we pay fully as much for material and twice as much for labor.

Sir B. Samuelson, M. P., has collected into a pamphlet report to C. M. Norwood a great mass of statistics, showing the disadvantage English shippers are under as compared to the German and Belgian.

And according to the *Daily News* (London): "A large and influential deputations headed by Lord Henniker from the Railway Rates Committee of the Railway and Canal Traders' Association," comprising, besides lords and earls, twelve members of the House of Commons, lately waited on Mr. Mundella, President of the Board of the Trade, to bring before his notice the necessity for a reform in railroad freight tariffs. Lord Henniker referred to Mr Mundella's acquaintance with the question which, though not a new one, had been stimulated by the great depression of trade and agriculture, and thought the present Railway Commission (which Hadley says has power enough to annoy the railroads, has not power enough to help the public efficiently) had, no doubt, done some good work. but was not so easy of access to the traders as it might and should be; referring to the American Commissions, which had far greater powers than the English courts of law had, being able to initiate an action on behalf of any trader who was badly treated and to hear appeals!

One great grievance was that American cheese goes to London through Cheshire at a cheaper rate than the cheese made in Cheshire goes from that county to London, while the freight on hops from abroad to London is less than from Kent to London. And Mr. Bartley said that American cattle killed in Glasgow were sent to London at two-thirds the rate of Scotch cattle killed in Glasgow; adding that "they did not want Protection or Fair Trade,' but they wanted a new system of charging by the truck" (car). But like professional reformers they omitted to say anything of a frequent practice of the English roads to charge from ten to fifty per cent. less freight on goods intended for export than on those for home consumption.

The truth is that England lives by importing unfinished product for consumption or manufacture and exporting finished; hence the roads, logically, make the import of the one and the export of the other as cheap as seems possible to them, making the local traffic, which they are sure of, pay the fixed charges and profits; in fact in some cases lower charges on goods for export are required by the provisions of their charters.

Mr. Mundella in reply referred to the many millions invested in railroads and the vital interest the investors had in those millions, but failed to commit himself any further than to promise a bill dealing with the subject.

The last number of the *Financial News* (London) has a long interview with Mr. M. R. Jeffards, C. E., an American sometime resident in London, on this subject, who gives many interesting figures, some of which will be referred to later in connection with Sir Bernard Samuelson's pamphlet, and charges that the high cost of freights is due to the conservatism of the English railroad managers in not adopting American improvements, particularly the truck, which he holds is an unnecessary prejudice, "when in fact it was first advocated by Robert Stephenson himself, when he proposed the device of the bogie to Mr. Robert L. Stevens, who was then (in 1830) building the Camden & Amboy Railway as a proper means of traversing curves."

Mr. Jeffards thinks the Government should appoint a commission selected from both Houses of Parliament, and invite the Institution of Civil Engineers of England and the American Society of Civil Engineers, each to select one of their most competent men as a member of the commission to examine the case thoroughly. It has been rumored that such a plan would be proposed, and the commission could hardly fail to elicit a great deal of information highly valuable to both countries.

American Versus English Bridges.

We are indebted to Prof. J. A. L. Waddell, of the University of Tokio, Japan, for the following copy of Prof. Kernot's opinion of American bridges, and also the extracts from a personal letter to Prof. Waddell:—

TO THE EDITOR OF THE "JAPAN MAIL."

Dear Sir,—I beg to add my contribution to the discussion of the above question in your pages.

I am an Englishman and have never been in America. I do not know any American Engineers. I have seen only one bridge of American construction, and that a small one. My professional training has been under English Engineers, and any bias that exists in my mind is naturally in favor of English ways of doing things. Nevertheless, I am convinced that American bridges are far in advance of the usual English type of shallow lattice girder.

I have been led to this conclusion first, by mathematical investigation; second, by numerous experiments upon models of card board, wood or iron, which I have tested and broken down.

My first objection to the English type of bridge, of which we have many examples in Australia and particularly in New South Wales, is that the main girders are too shallow. Our bridges are usually 150 span in the clear, and the main girders are only 12 feet deep in the older bridges and 15 feet in those erected during the last two years. Comparing one of our main girders 12 feet deep with one of American type 22 feet deep, I find that, with each part made the exact theoretical size under British Board of Trade Rules, the American girder will contain less iron than the English in the ratio of 63 to 100, or 27 per cent. of saving in material.

Secondly, in the English bridges, as we have them in Australia, there is a large excess of material over what is required by calculation in certain parts. Did this excess obtain throughout the whole girder it would simply mean a stronger bridge. But this is not so. The excess occurs in certain parts only, while the rest is only the theoretical size. This element of waste is seen in the huge and unscientific "end boxes" which are so common on English lattice girders, and also in the minor diagonals of closely latticed girders which for practical reasons have to be made much stouter than calculation requires. In American bridges the metal is concentrated in a smaller number of bars of massive section and which can be designed much more closely in accordance with the requirements of the theory. Thus not only are American girders theoretically more economical, but the practical excess of material above what theory requires is much less than in the other form.

Thirdly, the upper chord of a girder, being in compression, tends to bend sideways, and so evade its duty especially if it be comparatively long and narrow. This tendency was very apparent in my experimental models. It is met and most effectively provided for in American deep girders by a system of horizontal bracing binding the two top chords together into a most efficient horizontal truss. Unfortunately all our English girders are so shallow that the funnel of the locomotive rises some feet above the top of the girder. Hence this most vital bracing is either omitted altogether, or is carried out in a costly and imperfect way consisting of a series of complicated arches rising above the engine funnel.

Our bridges stand, I cannot deny that, but all my actual experiments lead me to look upon them with more or less misgiving as by no means possessing that margin of strength against hurricanes, and other contingencies which is desirable. A bridge ought to be laterally braced against wind and vibration at rail level and also at the top chord, as the American bridges are. Ours unfortunately can hardly be said to be braced at all at the top chord, while at rail level many of them are so weakly braced as not to calculate out properly for 10 pounds per square foot wind pressure—while American bridges, by good makers, are always made safe at 30 pounds.

Again, as to intensity of stress; good American bridges never go above 5 tons per square inch in tension or 4½ tons in shearing—while in some of the Australian bridges the bottom chords are exposed continually to 7 tons per square inch in tension, and the rivets to the same in shear. Finally, in English bridges, or bridges designed locally by English engineers I have frequently found gross errors, arguing either great carelessness or lamentable ignorance. Some of these errors were even so serious that when pointed out they led to the alteration or condemnation of the structure. Some of them are referred to in the pamphlet I forward. Others will be found mentioned in the engineering journals (in *Engineering* June 6, 1884, October 10, 1884, and *Engineer* June 5, 1885). Though I have looked through very many published plates of American Bridges, I have never found any such errors as those referred to, but on the contrary have been uniformly struck with the intelligence and skill displayed by the designer.

Yours, etc.

W. C. KERNOT, M. A.
Professor of Engineering.
University of Melbourne, December 2, 1885.

In a personal letter of Prof. Kernot to Prof. Waddell, the former still further assails English methods, and illustrated by practical examples in a manner difficult to controvert.

As a beginning, Prof. Kernot states that about three years ago a tall iron road viaduct was constructed from designs by two of his pupils in a very sheltered spot but it was set upon faulty masonry, built under protest rom the bridge designers. This masonry subse-

quently failed somewhat, and a public scare followed. Mr. W. H. Greene, receiving £1,200 as Engineer of Railways, was called in to report upon it; he first proposed a "fearfully costly" reconstruction of the abutments and then condemned the bridge as dangerous because he calculated that it "would only resist fifty six pounds wind pressure."

After considerable public controversy and protest from Prof. Kernot, a Mr. Rowand, Chief Engineer of Roads and Bridges to the Colony of Victoria, was called in and he set to work to alter and strengthen (?) the structure. "The result was amazing; he spent hundreds of pounds in propping the piers, and when the abutments had failed, he introduced new spans." Owing to a local weakness in one vital bar these new spans, though very expensive, were only *half* as strong as the original structure. This weakness was pointed out and Prof. Kernot proposed publicly to make a bridge fifty per cent. stronger with the same material and cost, and to illustrate on models one-fourth size loaded to destruction, and he to bear all expenses if his proposition was not carried out. But Mr. Rowand maintained a discreet silence as before. Later *Engineering* decided in Prof. Kernot's favor.

"As an extraordinary example of ignorance in a slightly different direction take this specification of iron. 'The whole of the wrought-iron used shall be of good quality capable of bearing compression equal to sixteen tons per square inch, or a tensile strain of twenty tons per square inch without decreasing or increasing more than one 625th part of its length.' Now, will you believe that an iron viaduct costing for iron work more than £70,000 has just been completed near Melbourne under the above specifications?"

Prof. Kernot then shows a diagram of an eye-bar of which he says "there are hundreds of them in one of our largest structures, each enduring a working stress of forty tons." This bar is 8 inches wide, 1-inch thick, and has a 2½-inch pin-hole. As calculated by Prof. Waddell, the section through the center of the eye shows an increase in area of *six per cent.* above that of the bar as compared with the American practice of fifty per cent. excess; the compressive stress at the eye per square inch is sixteen tons, about three times the stress allowed by American practice.

The Professor then shows a double intersection Warren truss, as in two bridges near Melbourne, with the cross-girders carrying the load at the lower points of one system only; thus making one set of diagonals to carry *all* the loads, though the other set is equally massive but has comparatively *nothing to do.*

He also shows that in many hundred girders designed by James Brunlees, Past Prest. Inst. of Civil Engineers, the three low girders adopted contain nearly as much iron as two girders properly designed to carry the same load; and that the two would then be one-third stronger than the three objected to.

Prof. Kernot says that his "great trouble is that these bridges *don't tumble down.*" He says he knows of bridges where a dense crowd would load the iron in vital parts to fifteen tons per square inch, and yet they have stood for years. He can only explain this by supposing that they are never loaded with anything approaching their full load; but "they *may* fall at any moment."

Ship-Railway vs. Canals.

Elmer L. Corthell, C. E., in a late statement before the Sub-Committee on Commerce of the House of Representatives, argues very clearly the advantages of the Tehuantepec Ship-Railway over the rival projects.

After entering very fully into the commercial advantages of the location, the probable traffic and the effect of such a railway upon American interests, he discusses the three prominent routes practically as follows:

The Panama canal is 1200 miles further from the United States than Tehuantepec; it is to be a sea-level canal cut through the back-bone of the Continent. The torrential Chagres river is crossed by the line of the canal twenty-nine times, and this river often rises suddenly 40 feet above its normal flow or 90 feet above the bed of the canal. Mr. Corthell estimates that the rectification of the Chagres and its tributaries will cost $40,000,000. On the Pacific side, the canal crosses the Rio Grande eleven times, and the Obispo seventeen times. All estimates of ultimate cost of the Panama canal and the time required for its completion are necessarily vague.

As to the proposed Nicaragua canal, no place of a "free unrestricted waterway" has yet been submitted. The latest section of canal proposed is 3,492 square feet, while the present Suez canal is 3,700 square feet, and the section decided to be necessary by the International Commission of Suez is 8,576 square feet, nearly 150 per cent. larger than the last revised section for Nicaragua. In this canal vessels would have to navigate a channel running through *seven* miles of rock cutting, three miles of which would be 150 feet, with a maximum depth of 318 feet: in this channel the rock on each side would only be 14 feet from the ship's sides, and through this the estimated speed of "five miles per hour" is simply impracticable. The total distance of these restricted channels, including earth cutting, is nearly 100 miles. The estimates on the Nicaragua canal have been puzzling to say the least; the latest advanced by its advocates is about $64,000,000, but a revision of this with adequate prices used and a proper appreciation of the conditions under which work must be done, adds $71,000,000 to this original figure, and approaches more nearly the figures estimated by Maj. McFarland, U. S. Engr. It is estimated that four days would be the time consumed in the passage; and the cost of maintenance would also be excessive from the amount of material washed in by the tropical rains.

The Tehuantepec route, on sixteen of the main lines of commerce, saves 20,942 miles over the Panama route, or an average of 1,308. The nautical conditions about Tehuantepec are superior, favorable winds being always found, with excellent natural harbors on both coasts. It is easily defensible, being located in a strong neighboring republic and accessible by railroads. The climate is healthy, and the number of hardy natives is sufficient to materially assist in construction. The ship-railway conforms to the ground crossed; it does not disturb the natural drainage and is *above* the torrents. Finally the cost of transportation is no greater on the railway than it would be on the canal, and the railway can be inexpensively enlarged for a greater traffic without delay or inconvenience to business, a condition of affairs impossible in a canal.

The Tehuantepec Isthmus is especially adapted to a ship-railway. The distance across is only 134 miles, the summit 736 feet above the sea with gradual ascents; the ground is solid and building material abundant. A careful estimate of cost places it at $75,000,000.

European Railroads.

The following table compiled from the *Revue Generale des Chemins Fer* and Poor's Manual gives the length in miles of railroads opened for traffic in Europe and the United States on the 31st of December for the years mentioned:

	1883	1884	Increase.	Percentage.
Germany	22,311	22,827	516	2.31
France	18,463	19,379	934	5.05
Great Britain and Ireland	18,752	18,960	208	1.11
Russia and Finland	15,464	15,779	315	2.02
Austria	12,960	13,679	719	5.99
Italy	5,869	6,167	298	4.97
Spain	5,127	5,383	256	4.99
Sweden and Norway	4,946	5,072	126	2.45
Belgium	2,656	2,684	28	1.08
Switzerland	1,709	1,716	7	0.40
Holland and Luxemburg	1,566	1,649	83	5.28
Denmark	1,127	1 208	81	7.23
Roumania	944	995	51	5.39
Portugal	928	949	21	2.21
Turkey, Bulgaria and Roumelia	866	866	——	——
Servia	152	152	——	——
Greece	14	111	97	692.86
Total Europe	113,854	117,594	3,740	3.46
United States	121,402	125,379	3,977	3.17

The area of Europe is 3,823,383$\frac{32}{100}$ square miles, and that of the United States, not including Alaska, is 3,002,885, or including Alaska, 3,580,275 square miles.

This gives Europe one mile of railroad for 34$\frac{71}{100}$ square miles, and the United States a mile of road for either 23$\frac{95}{100}$ or 28$\frac{56}{100}$ square miles at the end of 1884.

The population of the United States in 1880 was 50,155,783, and of Europe about 310,000,000. This would give each mile of railroad in Europe 2,636 against 400 here, and on the same basis the area of the United Kingdom of Great Britain and Ireland, being 121,607$\frac{64}{100}$ square miles, and its population in 1886 35,246,562, a mile of railroad then would have tributary to it 6,$\frac{455}{1000}$ square miles, and 1,859 persons. It should be noted that the above comparison is influenced by the probable increase in population here since 1880, having been at the rate of 2½ per cent., while in the United Kingdom it may be estimated at the rate of one per cent., the rate of increase from 1871 to 1881 having been 10$\frac{7}{10}$ per cent.

Annual Report of the Engineer Department of the District of Columbia.

The report of Major J. Lydecker, U. S. Engineers, and Engineer Commissioner of the District of Columbia, is before us for the year ending June 30, 1885.

The total amount expended in the fiscal year was $646,099.18; the appropriation for the present year is $679,690.00 and the estimate for 1886-87 is $795,450.00. There are now 143.33 miles of improved streets and 91 miles still unimproved. Between 1871 and 1874 1,188,000 square yards of wooden pavement, covering 50 miles, were laid at an expense of over $4,000,000. In the last eleven years 719,796 square yards of this has been replaced with asphalt, 521,105; granite, 175,316 and asphalt block, 23,375 square yards, at a total cost of $1,509,095.

As to cost of various pavements, the report states that wooden pavement, as now laid in Chicago, cost as low as $1.14½ per square yard; this pavement is made of round cedar blocks, 7 inches deep, from 3-in. to 10-in. in diameter, laid on a flooring of 1½-in. planks, with a foundation of 3-in. of sand, and the joints filled with tar and gravel. As thus laid this pavement remains in good order under ordinary travel for from two to three years, and at the end of five years needs very extensive repairs, difficult to make on account of the irregular depth of the blocks, in seven years the pavement is completely worn out. Last year granite pavement was about $2.50 per square yard, including the five-year guarantee, as compared with $2.65 for the previous year (1884).

The standard asphalt pavement as laid in the District has cost for the last three years

about $2.25 per square yard. This pavement is made of refined Trinidad asphalt, softened with the residuum of petroleum oil and mixed with certain proportions of sand and powdered limestone, as already given in this journal. The report states that this pavement is almost noiseless, not slippery under ordinary conditions, offers little resistance to traction, is easily repaired and durable, and in many streets where it has been laid five, six and seven years is in perfect order without a cent expended for repairs. On other streets mistakes have been made in the mixture occasionally, and defects have appeared. During eight years the total expense, to contractors and the District, for repairing asphalt pavements, has averaged $3,750 per annum. During this eight years the average number of yards laid has been 427,000 per annum, so that the average annual expense for maintenance to-date has been nine-tenths of a cent per square yard per year.

The coal-tar or concrete pavements laid between 1871 and 1877 differed from the present standard pavements in two important particulars; first, the cementing substance was a product of the distillation of gas-tar instead of bitumen or natural asphalt, and second, the base was broken stone partly cemented with tar instead of being a rigid mass of concrete masonry. This pavement, owing to the volatile oils in the coal-tar and its sensitiveness to heat, was soft in summer and brittle in winter. Some of them went to pieces in less than two years, while others (in which a certain proportion of asphalt was mixed with the tar) are in good condition after ten years use and without any repairs at all. The average age of these pavements is now twelve years, and the average annual cost of maintenance has been about $60,000, or about 8 cents per square yard per year.

The asphalt-block pavements laid in small quantities since 1878, have not always been satisfactory, but the quality of the blocks has much improved within the last two years. The cost is somewhat less than asphalt, and its use is restricted to residence streets of light traffic, where it is entirely satisfactory with properly made blocks.

The cleaning of streets was done under contract with L. P. Wright & Son at 29½ cents per 1,000 square yards. The alley cleaning was done by contractor John White for 42½ cents per 1,000 square yards. Unpaved streets and alleys cleaned and ice and snow removed by days labor. The total expenses were as follows:

Cleaning paved streets (115,242,263 yds.)	$33,998.58
" unpaved "	3,434.91
Removing ice and snow	1,348.51
Cost of inspection	1,218.00
Total for streets	$40,000.00
Cleaning paved alleys (17,597,068 yds.)	$7,478.65
" unpaved "	905.49
Cost of inspection	1,480.00
Total for alleys	$9,883.64

The lowest bids for street-cleaning for the present fiscal year (opened May, 1885,) were 28½ for one year, 28¼ for three years and 27¾ cents for five years per 1,000 square yards.

There are 2,900 telegraph poles and 850 miles of wire attached to them in the city. The underground system is progressing; at the date of the last report there were six miles of conduit and 285 miles of wire; since then 1¼ miles of conduit and 574 miles of wire have been added, and the telephone company is now engaged in laying 2½ more miles with 519 miles of wire. When the last named work is completed there will be in the city 1,300 miles underground. All the laid lines are working satisfactorily, and all new poles are only erected under a written agreement that they shall be taken down when ordered by the Commissioners.

The older telegraph companies have not yet made much progress in underground wires. But the Baltimore & Ohio R. R. and the Western Union Company are now making plans which will remove nearly all the poles from the central part of the city.

The report of the Inspector of Cements and Asphalt has already been published in this journal.

Japanese Colored Metallic Alloys.

Mr. W. Chandler Roberts Austen, Chemist to the Mint in London, lately gave a lecture on the impurities in metals, which we condense as follows:—He referred especially to the famed colored metal work of the Japanese who have given much attention in their works of art to metallic alloys, some of them very remarkable for their colors.

The lecturer gave analyses of various Japanese alloys. The *Shaku-Do* contained copper 94.5, silver 1.55, gold 3.73, and traces of lead, iron and arsenic. Large statues are sometimes cast of this metal. *Kuromi* contained copper 98.04 parts, antimony, 1.96. Japanese bronze contains for the *Sawari*, copper 76.9, tin, 23.1; for the *Viarakane*, copper 87.0, tin 13. These bronzes sometimes contain 12 per cent. of lead and often 6½ per cent. of zinc. *Shibu-Ichi* contains copper 67.31, silver 32.07, lead 0.52 and a trace of gold; this metal is sometimes one-half silver.

The Japanese make their *Moku-Me*, which signifies "wood-grain," by laying plates of metal of different colors over each other and then boring conical holes of varying depths into the layers; the mass is then hammered down until the holes have disappeared and the composite sheet has parallel exterior surfaces.

The Japanese also vary the tints of their metals by means of pickling solutions. The beautiful red tint of some of their metals is due to cuprous oxide. Sulphate of copper, verdigris and salt are among the most common components of their pickling solutions. The purple of the *Shaku Do* is supposed to be due to the presence of gold.

PERSONAL.

R. H. TEMPLE, by Circular No. 1, dated Memphis, March 20, 1886, is appointed Chief Engineer of the Virginia Construction Company.

GENERAL J. H. DEVEREUX, President of the Cleveland, Columbus, Cincinnati & Indianapolis R. R. died at Cleveland, O., March 17th.

JOSEPH O. OSGOOD has been appointed Chief Engineer, in charge of maintenance of way, of the Toledo and St. Louis Division of the Toledo, Cincinnati & St. Louis R. R. H. A. YOUNG is Assistant Engineer.

CHARLES DOUGLAS FOX, M. Inst. C. E. and Cor. M. Am. Soc. C. E., it is reported, is to be knighted by the Queen for his engineering work in connection with the Mersey Tunnel.

COL. AMOS STICKNEY, U. S. Engineers, is now in charge of the Louisville & Portland canal and Wabash river improvements, having relieved Col. Merrill to that extent.

E. A. COOPER, superintendent of the Indianapolis Car Works, severs his connection with that institution April 1st, and has accepted the position of general superintendent of the St. Louis cable road.

WILLIAM FULLER, late superintendent of motive power of the New York, Pennsylvania & Ohio R. R., has been tendered by E. B. Thomas, General Manager, the same position on the Richmond & Danville R. R.

CHARLES W. BUCKHOLTZ, for many years attached to the engineer corps of the Philadelphia & Reading R. R., has been appointed Chief Engineer of the Erie R. R., with headquarters at New York.

W. B. SMELLIE, formerly assistant to the Chief Engineer of the Canadian Pacific, and later Consulting Engineer of the same company, has been appointed Chief Engineer of the Brockville, Westport & Sault Ste. Marie R. R., with headquarters at Brockville, Ont.

CHARLES LATIMER, Chief Engineer of the New York, Pennsylvania & Ohio Railroad, resigned his position March 1st, and it has been accepted by Superintendent Clements with regret. Mr. Latimer has been with the road since 1873.

N. J. HARRIS, who was City Surveyor of Oswego, N. Y. from 1874 to 1882—during which time the officer was regarded as "out of politics"—has been again endorsed as the "right man in the right place," by his appointment to the office—again non-political,—on the 9th inst.

P. C. COWAN, B. Sc., A. M. Inst. C. E., has been appointed by the Lord Lieutenant of Ireland to a County Surveyorship, for which an open competition, extending over ten days, was recently held by the Civil Service Commissioners. Mr. Cowan, who is a son of Councillor Cowan, Dundee, was a distinguished graduate of Edinburgh University, and acted for some time as assistant to the late Mr. Fleeming Jenkin, Professor of Engineering. He was at one time a member of the engineer corps of the N. Y., West Shore & Buffalo R. R., and wrote the article on that railroad reprinted in this journal.

HERR JOHANN VON UNRUH, the well-known German railway contractor, died recently, at Berlin, at the advanced age of eighty. The deceased, who was born at Tilsit, studied architecture at the Berlin Academy, and subsequently became a Governmental inspector at Breslau, as well as Councillor at Gumbinnen and Potsdam. He was elected director of several important industrial and manufacturing associations, and was the chief builder of the Upper Silesia railroads and the lines running from Potsdam to Wittenburg. He sat as deputy for Madgeburg in the two first Diets of the North German Confederation and in the Reichstag of the German Empire. Herr Von Unruh was likewise the author of works on other subjects, amongst them being "Sketches of the Modern History of Prussia" and "Experiences of the Last Three Years," the former of which appeared in 1849, and the latter in 1851. —*Builder.*

Iowa Engineers.

At the second meeting of the Iowa Society of Civil Engineers, held in Cedar Rapids on the 17th. C. W. Irish read a paper on "Magnetism and Magnetic Variation in Iowa."

The full list of membership is:

F. A. McDonald, Cedar Rapids; Wm. Steyh, Burlington; C. W. Irish, Iowa City; J. C. Laas, Marion; G. A. Mitchell, A. W. Swanitz, Cedar Rapids; M. Tschirgi, Jr,, Dubuque; H. F. White, Cedar Bapids; Fred Hess, Ft. Dodge, J. A. Mathewson, Muscatine; J. M. Brown Cedar Rapids; R. H. Ashton, Boone; P. F. Randall, Cedar Rapids; W. H. Knowlton, Dubuque; J. E. Lyman, Cedar Rapids; R. W. Bushnell, Cedar Rapids; Frank Tullis, Iowa City; Garrett Davis, Riverside; Joseph Dudley, Riverside; J. A. Brown, Vinton; W. J. Greene, Cedar Rapids.

The society adjourned to meet in Cedar Rapids, in July, at call of president and secretary.

Southern Society of Civil Engineers.

At the meeting held on the 15th, at Jacksonville, Fla., Col. Jas. G. Gibbs of Quincy, Fla, Chief Engineer of the Green Cove and Midland Railway was elected member of the Society.

E. W. Page Couper, of Bartow, Fla., Chief Engineer of the Florida Southern Railroad, and L. S. Randolph, Mechanical Engineer, of Fernandina, Fla., Superintendent of Motive Power of the Florida Railway and Navigation Company were proposed.

The following gentlemen were propcsed as honorary members: Major-General Q. A. Gillmore, Colonel of Engineers, U. S. A., and E. G. Woodford, Associate Member Institute of Civil Engineers (England) City of Mexico, Mexico.

A paper was read on "The Desirability of the Establishment of a True Polar Meridian and Standard of Length in each county of the State."

Next meeting will be held on April 19th.

CORRESPONDENCE.

Problem.

EDITOR ENGINEERING NEWS:

The radius to cut off one acre from a circular field of ten and a half acres, the radius of which is 381.56—is 175.315 feet according to calculation of W. C. S. Keokuk, Ia.

Depth of Arch Stones Under Embankments.

GLENWOOD, 23rd WARD,
PITTSBURG, PA., March 22, 1886.

EDITOR ENGINEERING NEWS:

Referring to the query of St. O. Nearch, in your issue of March 6, 1886, regarding the depth of arch stones under embankments of varying heights, I would respectfully offer the following empirical formula for the consideration of engineers generally:

$$D = \frac{\sqrt{(S-R)10+2H}}{8}$$

S = Span of arch in feet.
R = Rise of arch in feet.
H = Height of embankment above arch in feet.
D = Depth of keystone in feet.

The subjoined tables show the application of the formula to a few varying cases:

Tables of depths of keystones for arches of first class cut stone as for above formula.

No filling over arches.

Span feet.	Rise in parts of span.			
	1-2	1-4	1-6	1-10
10	.88	1.08	1.14	1.18
20	1.25	1.53	1.61	1.68
30	1.53	1.87	1.98	2.05
40	1.77	2.16	2.28	2.37
50	1.98	2.42	2.55	2.65
100	2.80	3.42	3.61	3.75

10 feet filling over arches.

Span feet.	Rise in parts of span.			
	1-2	1-4	1-6	1-10
10	1.04	1.22	1.27	1.31
20	1.37	1.64	1.71	1.77
30	1.63	1.95	2.05	2.13
40	1.85	2.23	2.35	2.43
50	2.05	2.48	2.61	2.71
100	2.85	3.47	3.65	3.80

50 feet filling over arches.

Span feet.	Rise in parts of span.			
	1-2	1-4	1-6	1-10
10	1.53	1.65	1.67	1.72
20	1.77	1.98	2.04	2.11
30	1.98	2.25	2.34	2.40
40	2.16	2.50	2.60	2.68
50	2.34	2.72	2.84	2.93
100	3.06	3.64	3.82	3.95

Respectfully,
EMILE LOW.

Sinking of the Oregon.

18 BROADWAY, NEW YORK, March 24, 1886.

EDITOR ENGINEERING NEWS:

There is one view of the accident by which the splendid steamer Oregon was so unaccountably lost, which it seems to me should be taken by an engineering paper, and might prove of use to some future dismayed navigator who has the misfortune to have a hole made in the vessel committed to his care.

To state the case as it is generally supposed to have been, the ship was injured in the side, and in from seven to eight hours took in enough water to sink her, the quantity so taken being, say, from three to six thousand tons (of 2,240 pounds) according to the various estimates of the floating power of the steamer. This water flowed in, we may say, under an average head of 4 feet below sea level, and if the aperture was a circular one, the diameter required to produce all this was less than 10 inches.

The effect of collision with a schooner is not apt to be a smooth round hole, but a crushing in of the iron side making a large number of small ruptures where the riveted seams gave way, and if some such remedy as letting canvass down on the outside of the ship had been resorted to, the comparatively small amount of flow could have been rendered a great deal smaller, and by pumping the sinking might have been avoided.

The pumping arrangement available on a steamer of the Oregon's size and steaming capacity ought certainly to have been of more than thirty horse-power, and if that had been put at work it should have kept the ship afloat against a leak of the size this proved itself to be.

Stories about a hole in the side as large as a barn door may do for people whose experience has mostly been in agriculture, but men should be put in charge of large passenger steamers and their machinery who will, and can in time of peril coolly face the danger, long enough at least to make a rough calculation of the extent of the damage, and to remember that if properly handled, a hundred or more skillful and disciplined men well directed can be made to accomplish a great deal in seven hours.

A large shot-hole below the water line, or the breaking of one of the outboard pipes from the engine, are injuries as serious as this to the Oregon, and are met as matters of course and promptly repaired, and why was not something done in her case to take advantage of the seven hours opportunity.

Would it not be well for officers of vessels to be given enough training in the elements of hydraulics to be able to judge roughly on the instant of the difference between a rupture which will sink the ship in a few minutes, and on which it would be madness to waste precious time, and one where the time of sinking will be postponed for hours and give every chance to stop or check the leaks. A few questions in the examination of candidates for masters' certificates, as to how large a hole in certain circumstances would admit 1,000 tons of water, might cause him to think when the water actually came into his ship, with more coolness and confidence from having used his thoughts in that direction previously.

JOHN F. WARD.

LITERATURE.

State of Rhode Island and Providence Plantations. Annual Reports of the Commissioner of Dams and Reservoirs, made to his Excellency AUGUSTUS O. BOURN, Governor, January 1, 1885.

The above report, though late in appearing to us, is a step in the proper direction of a thorough State inspection of so important a class of public works as dams and reservoirs. The purpose of this inspection is to ascertain the capacity and stability of these impounders of water. The dams have been measured, and in the present reports are 106 diagrams representing a number of the more important structures in the State. The Commissioner reports that in certain dams where there is danger from leakage, the fact is conclusive that the *quantity* of material used was a greater desideratum with the builder than the *manner* of its disposition. There are 415 artificial reservoir structures in the State, and of these each has been personally inspected by the commissioner, had its location defined and generally described.

Official Report on New Ordnance Material to U. S. War Department. BY CAPTAIN W. H. BIXBY U. S. ENGINEER 1885.

The American *Engineering News* has been giving in some detail the substance of the report named above. A valuable summary of various systems of checking recoil will be found in the number for Nov. 14th last. The Krupp ball-and-socket non-recoil gun, and non-recoil trunnion pivotted gun, as well as his slight-recoil pivotted gun, are briefly noticed. No opinion is given in this number, so we have little to say here. Illustrated descriptions of the two first were given in THE ENGINEER of Aug. 15th, 1879, and of the last, which is a more recent design, in THE ENGINEER of Oct. 13th, 1882, p. 370. The Aibini Armstrong carriage is also noticed, with a cut showing action, and another Armstrong non-recoil design is mentioned, which is applicable to guns of the largest calibre not yet made public—General Inglis' idea of a yoke or frame made in the gun port, on a circle concentric to the pivot on which the gun traverses. The gun carriage is attached to the yoke frame by means of its water buffer pistons, and its recoil is thus efficiently checked. The same cut in the report will be found on a larger scale with description in THE ENGINEER of July 29th, 1881, p. 77, 73, and 74, to which Capt. Bixby gives a reference with regard to front parapet anchorage, which he notices next. (The work must be valuable, judging from the summary. He has collected together a number of designs of the same character, in fact, a larger number than we had realized the existence of, as they have come out in very different times and places. Capt. Bixby contrasts well with many writers in the full acknowledgment he makes of any sources of information. This is the more to be noticed, as we remember Capt. Bixby's visit to this country, and the fact of his being present at experiments at Shoeburyness. Many writers, under the circumstances, would have employed any reports made at such experiments without thinking it necessary to name them, though giving references certainly does not in any way weaken the weight of a writer's opinions, but rather the reverse, for it generally bespeaks a man of weight. A man who refers to all sources of information that he knows, takes the position of reviewing and giving his judgment on all that he can lay before his readers. A man who appears anxious to put everything as the result of his own observation, seems on the face of things to be likely to be more curtailed in his range of view, or else to be quoting more than he admits; moreover, he appears rather to claim to be a reporter than a judge.—*The Engineer*, Jan. 22.

Tables for Calculating the Cubic Contents of Excavations and Embankments by an Improved Method of Diagonals and Side Triangles. By JOHN B. HUDSON C. E. Second edition, revised and enlarged. New York, John Wiley & Sons, Publishers. 1886. Size, 6 by 9 inches; p. 79, $1.00.

These tables are simple and accurate; the new principle being the use of the side triangles, made up of the parts touched by the diagonal, and the tables of side triangles. The method adopted is illustrated by plain diagrams, and the tables are arranged for nearly every possible width of roadway and slope, and cuttings or fills from zero to 50 feet. The use of the tables is simple, and the typographical work is excellent, a feature too often neglected in works of this description.

Reports of City Engineers and Water-Works.

Des Moines, Iowa, sends in the "First Annual Report" of its City Engineer, Mr. B. Schreiner, reporting the work done in the direction of public improvement in 1885. The report is accompanied by a number of excellent detail plans of the city, showing the location of sewers and other new work.

East Saginaw, Michigan, through its City Engineer, Mr. T. Appleton, sends in the "First Annual Report" of its Board of Public Works. Judging from the "comments and suggestions" of the city engineer, the practice of this new board in its constructive work is up to the latest.

Cambridge, Mass., through the City Engineer, Mr. Wm. S. Barbour, also reports excellent progress, but nothing to warrant special remark.

Reports of Water Boards have been received from Lawrence, Mass.; Cambridge, Mass.; Middletown, Conn.; Allentown, Pa.; Bay City, Mich., etc.

Journal of the Association of Engineering Societies, Vol. 5, No. 4, February, 1886.

CONTENTS:—The Distribution System of Boston Water-Works, by DEXTER BRACKETT; Railroad Oracles, by HENRY B. MASON; Fireproof Buildings, by THEODORE ROSENBERG; Some Considerations of the Relation of Bed to the Variables in River Hydrants, by JAMES A. SELDON; An Inverted Syphon Tunnel for Improving the Water Power of the Illinois River at Marseilles, Illinois, by EBIN J. WARD; The Development of Transportation in Northern Ohio, by JOHN H. SARGEANT.

Transactions of the Technical Society of the Pacific Coast. October, November and December, 1885.

CONTENTS:—Dynamite Catastrophes, by FRED. H. JENSSEN; Remarks on the Principle of the Logarithmic Slide Scale, by HUBERT VISCHER. The Gold Schmid Aneroid, by GEO. J. SPECHT.

Same, for January and February, 1886.

CONTENTS:—Statement of Physical Conditions effecting Pacific Coast Harbors, with some Reflections, by GEO. H. MENDELL; Kutter's Formula, by P. J. FLYNN.

Proceedings of the Institution of Civil Engineers Selected Papers.

The Steam-Engine Indicator. Comprising the following papers: I. On the Theory of the Indicator and the Errors in Indicator-Diagrams, by OSBORNE REYNOLDS. II. Experiments on the Steam-Engine Indicator, by ARTHUR WM. BRIGHTMORE with an abstract of discussions.

High-Speed Motors and Dynamo Electric Machines. Comprising the following papers: I. High-Speed Motors, by JOHN IMBRY. II. Continuous-Current Dynamo-Electric Machine and their Engines, by GISBERT KNAPP, with an abstract of discussions.

On Construction in Earthquake Countries, by JOHN MILNE, F. G. S.

On the Energy of Fuel in Locomotive Engines, by GRANVILLE CARLYLE CUNNINGHAM.

No. 11. Water Pressure in Mains of Various Cities.

COMPILED BY J. J. R. CROES. FROM SPECIAL RETURNS, JAN., 1886.

Town and State.	Topography.	Difference of level in town.	In Business District.		
			Day Pressure.	Night Pressure.	Fire Pressure.
		feet.	lbs.	lbs.	lbs.
Burlington, N. J.	level.	0	20	25	——
Butte City, Mont.	hilly.	——	60	——	60 to 80
Cambridge, Mass.	flat.	21 to 71	25	28	25 to 28
Conshohocken, Pa.	hilly.	200	60	——	——
Dutch Flat, Cal.	hilly.	80	21	21	65
Eureka, Nev.	hilly.	100	45	55	100
Gunnison, Col.	level.	——	85	85	100 to 150
Henderson, Ky.	——	small.	30 to 80	0	30 to 80
Hillburn, N Y.	level.	0	25	25	25
Independence, Mo.	rolling.	0	25	25	——
Ionia, Mich.	hilly.	100	65 to 80	65 to 80	100 to 110
Jacksonville, Fla.	rolling.	20	45	45	90 to 110
Jacksonville, Ill.	rolling.	0	45	40	160
Keeseville, N. Y.	hilly.	70	65 to 70	65 to 70	100 to 200
La Fayette, Ind.	hilly.	124	65	70	150 to 400
Mahanoy City, Pa.	hilly.	——	60	60	65
Negaunee, Mich.	hilly.	15 to 20	30 to 40	30 to 40	80 to 100
Olathe, Kan.	level.	——	60	30 to 40	——
Parkdale, Ont.	sloping.	87	60 to 65	40 to 45	85 to 90
Red Bluff, Cal.	sloping.	12	20	20	20
St. Catharines, Ont.	——	258	73 to 75	75	75
Taunton, Mass.	level.	0	40	45	40 to 120
Union City, Pa.	rolling.	10 to 30	40	35	60 to 100
Waltham, Mass.	level.	0	56	57	56 to 57
Yonkers, N. Y.	hilly.	350	140	130	130 to 140

THE HISTORY AND STATISTICS OF AMERICAN WATER WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.; M. INST. C. E.

801. CHAMPAIGN AND URBANA, ILL.

The cities of Champaign and Urbana in Illinois are adjacent to each other, in lat. 40° 7′ N., long. 88° 14′ W., on level ground 720 feet above the sea level. They are in a rich agricultural region and are at the intersection of two important lines of railroad, the Illinois Central and the Indiana, Bloomington & Western.

Water-works were constructed by a private company in 1885, after plans of T. J. Whitman, C. E., and under superintendence of Charles H. Ledlie, taking the supply from an abandoned prospecting coal shaft, 8 by 12 feet in dimension, and 80 feet deep. The water-level before pumping was 40 feet below the surface.

The water is pumped directly into the mains, by two vertical compound pumping engines, built by Gordon & Maxwell, of one and a half million gallons combined capacity. The steam cylinders are fifty feet above the pumps. These pumps also supply a reservoir of 250,000 gallons capacity, built in excavation and embankment lined with brick and laid in cement, from which a high-pressure duplex pump will draw its supply for a fire pressure of ninety pounds per square inch.

Distribution is by cast-iron pipe, of which there are seven miles in Champaign, with fifty fire hydrants and five miles in Urbana with forty fire hydrants. No statements of costs are furnished. The bonded debt is $100,000 at six per cent. The population of Champaign in 1880 was 5103, and that of Urbana, 2942. H. Trevet is President, and W. B. McKinley, Secretary.

WATER

WATERVILLE, ME., is to have electric light.

THE citizens of Grand Rapids, Mich., will be asked to vote $75,000 for water-works.

A COMPANY has been formed at San Antonio, Texas to erect an electric light plant. Capital, $25,000.

A COMPANY has been organized at Fairfield, Me., to introduce electric lighting.

THE Allegheny County (Pa.) Electric Light Company has begun work in Allegheny grading for a new factory.

THE city of Millbank, Dak., is advertising for bids for putting in mains, furnishing pipe, hydrants, etc.

THE Thompson-Houston Electric Light Co. have received the contract to light Selma, Ala.

WASHINGTON, PA., is to be lighted by the incandescent light.

WATER-WORKS are to be built at Fernandina, Fla., by the Florida Railway and Navigation Co.

F. H. THOMAS, Shippensburg, Pa., has the contract for the erection of water-works at that place. Cost $35,900.

THE Maryville Water Company, Maryville, Mo., capital stock, $50,000, has been incorporated by George B. Kinney and others.

MICHIGAN CITY, IND., has closed a contract for the Jenney electric light. The company puts up a forty light plant for $7,500.

A $50,000 electric light company has been chartered at Charleston, S. C. A plant will be erected at once, using the Thompson-Houston system.

ENGINEER RIDER, of Norwalk, Conn., has been surveying along the line of Stony Brook and says that Darien can build water-works for $18,000.

THE Mutual Gas Light Co., Augusta, Ga., capital stock, $200,000, will build works as soon as the charter is obtained.

THE citizens of Concordia, Kan., are discussing the question of water-works, and have appointed a committee to investigate the matter.

WATER-WORKS will probably be erected at Union Bridge, Md., by the city and the Western Maryland R. R.

THE Delaware, O., Water-Works Committee has made a report to the City Council recommending the appointment of J. T. Cook, of Toledo, as engineer of construction.

THE contracts, of Cleveland, O., with the Brush Electric Light and Power Company and with Harrison & Many for vapor light have been approved.

THE Colorado Springs Land and Water Company, incorporated, capital stock, $50,000; The Beaver Water Supply Company, incorporated, capital stock $250,000.

The Capital City Water-works, Montgomery, Ala., a new corporation, are putting in a $350,000 plant for their new artesian well. The water will be ready for use next month.

THE citizens of Whitestone, L. I., at a special election decided to urge the passage of a bill by the Legislature to bond the village in the sum of 50,000 for local improvements.

THE water-works Commissioners expect to extend the water mains of Atlanta, Ga., this spring and summer, some 1,300 feet, also to utilize the water from the artesian well.

THE German Ditch and Reservoir Company has been incorporated. The principal place of business is Erie, Col., and the capital stock is $1,500; Directors are Henry Holting, Albert Christnic and William Bointz.

THE City Council of Kankakee, Ill., on March 22d, granted a franchise to Hinds, Moffat & Co., for building a water-works on the modified gravity system. The yearly rental is $5,000; 8¾ miles of pipe. The population of Kankakee is 7,000.

THE Equitable Gas Company, of Memphis, Tenn., has been organized. Capital stock, $500 000. F. H. Milburn, President; John W. Cochran, Vice-President; Wm. Kathenberger, Treasurer.

THE citizens of Redfield, Minn., intend to sink an artesian well this season, with a fall of about 50 feet from the surface. This, with the usual amount of pressure of wells in the locality, would give a power estimated at least 100-horse power.

THE contract for the construction of the reservoir for the new water-works for the city of Bombay, has been secured by Messrs. Glover & Co., Edinburgh, (Scotland). The reservoir, it is said, will be the largest artificial lake in the world.

SAMUEL MCELROY, C. E., has just given, to the Constitution Club of Brooklyn, a very condensed but satisfactory historical sketch of the original and present state of the Brooklyn Water-Works. The lecture has been issued in pamphlet form.

THE water supply of New Castle, Del., is to be improved. The None-Such Creek Marsh Co. will dredge the creek to a depth that will insure an unfailing supply of pure water. The National Dredging Co. has contracted to do the dredging for $6,000, of which the water company will pay $3,500.

THE Montclair Lateral Irrigation Company has filed a certificate of incorporation. Its Directors are Francis H. Olmsted, Matthew P. Cochran, Ezra M. Bell, C. P. Haskell and Nelson L. Linnnell, and its field of operations in Arapahoe county, Colorado.

PRAIRIE-DOG WELLS.—A Nebraska man has settled the question of how prairie-dogs obtain the water they drink. He says they dig their own wells, each village having one with a concealed opening. He knows of one such well 200 feet deep, having a circular staircase leading down to the water.

THE City Council of Ft. Scott, Kan., have granted a franchise to E. P. Knapp authorizing him to lay mains and service pipes throughout the city for the purpose of lighting the city with natural gas, at a cost to private consumers of not to exceed $1 per 1,000 feet, and not to exceed $8.33½ per post for street lighting.

IT is said that Georgia's great swamp, the Okefeenokee, can easily be reclaimed by drainage into the St. Mary's river, only a few miles distant, and a magnificent area of land made ready for the plow. Great sections of swamp land in Florida have been reclaimed by methodical drainage carried out by a company formed for the purpose.

LAND DRAINAGE.—A. L. Luce, of Toledo, O., and G. L. Luce, of Louisiana, will at once begin preparations for the purpose of draining Little river within the boundary of New Madrid county, Mo. They will build a dredge boat near Little river station. It will be 65 feet long and 20 feet wide, and the machinery for it will soon arrive. It will be 40-horse power. They are to cut a channel 27 feet wide, and the depth will depend on the fall they find after making a careful survey. A partial survey has already been made, and the fall found to be about one foot to the mile. These and other parties have entered into a contract with the County Court of said county to do this work, which will prove of great benefit to the surrounding country as well as that immediate section, and it will probably be the means of Stoddard and Dunklin counties entering into similar contracts, they receiving for their compensation certain portions of swamp lands.

PUEBLO, COL., March 15.—At a meeting of the Pueblo City Council to-night a committee was authorized to make the best terms possible with Geo. E. Waring, sanitary engineer, for the surveying and platting of the city for a complete and perfect system of sewerage. Mr. Waring will be invited to come here and make his plans.

THE Frankfort, Ky., Water Company has now over five hundred subscribers for water, some three hundred and fifty of whom have already had their premises fitted up, and are now being supplied with water; the remaining subscribers, with additional ones to be expected, should afford considerable plumbing work. There is but one regular plumbing establishment in Frankfort, and it is believed that another plumbing establishment could be conducted there with profit.

THE Board of Trustees of Mount Vernon, N. Y., have signed the franchise to the Mount Vernon and New York Water Company to lay mains through the village. President, F. Hopkinson Smith; Vice-President, Moses R. Crowe; Secretary and Treasurer, G. L'Hullier. They have entered into a contract with the Inman Brothers to do the work and will expend about $200,000. The pumphouse at Hutchinson creek, where the water is obtained, will cost about $8,000.

GOODHUE & BIENIE, water-works contractors, have lately received a large order from Streator, Ill. The system embraces about twelve miles of pipe, from 16 to 6 inches in diameter; a stand pipe 125 feet high, and a pump that has a capacity of 3,000,000 gallons in twenty-four hours. The cost will be from $150,000 to $175,000. The iron pipe has already been bought. The contract for the hydrants, pump, etc., has not yet been awarded. The entire work will be completed by September. The town has a population of 15,000.

THE Washburn, Wis., Electric Power and Lighting Company has been organized, its chief object being to run street cars by electricity. It will also do a lighting business, using O'Beirne towers. Capital stock, $500,000. Van Depoele motors and the Excelsior lighting system will be employed. The wiring will be done underground by the use of the Beere Grant conduit system. President, C. I. Critchett; Engineers, Col. O. C. Sheldon; Captain Edward Hudson; Electrician, Prof. L. M. Dickerson; General Manager, Major M. C. Lincoln.

A COMPANY with $1,000,000 capital stock has been organized to dredge Carson river, in Nevada, for quicksilver and amalgam. Eighteen miles of the river bed have been located. It is estimated that 10 per cent. of the bullion product of the Comstock mines has flowed as tailings into the Carson river, and that at least $40,000,000 will be recovered. The enterprise is backed by Boston capital, and the projector, Dr. Rae, has dredges at work at New Grenada, which have been successful in recovering much treasure from the river beds.

THE Connecticut Legislative Committee reported in favor of chartering the Citizens Water Company, of Bridgeport, Conn., and the House, Senate and Governor have approved. The charter grants exclusive right to the water of Mill river to the new company, which has perfected its organization, and opened subscription books. Capital stock, $500,000. The supply will be by gravity and will be taken at a point on Mill river about six miles from the city. The mains will be 30 and 24 inches. Total head to mean high tide, 210 feet. The dam will be of masonry, 35 feet elevation. Proposals will be asked for through the ENGINEERING NEWS AND AMERICAN CONTRACT JOURNAL. B. H. Hull, of Bridgeport, is the engineer.

THE following are the requirements for a truly good pure, potable water, as prescribed by a scientific commission in Belgium a short time ago: (1) It must be clear and transparent; (2) it must be of agreeable taste, and not warmer than 15° C.; (3) it must contain some air and some carbonic acid; (4) it should not contain more than twenty milligrams of organic matter per litre; (5) it should not contain more than 0.5 milligram ammonia per litre; (6) it should not contain algæ, infusoria, or bacteria; (7) upon addition of some cane sugar no bacteria must be developed; (8) the water should not contain nitrites nor sulphuretted nitrogen, and not give a precipitate with sulphide of ammonium; (9) it should not contain more per litre than 0.5 grain mineral salts. That is not the water they have in Philadelphia.

NEWS OF THE WEEK.

Railroads, Bridges and Canals.

The St. Louis & Emporia R. R. from Kincaid, Kas., west, will be commenced shortly.

The Rome, Watertown and Ogdensburg R. R. will build about twelve miles of road. General Manager, H. M. Britton, Oswego.

The Wekiva Spring, Bronson & Northwestern R. R. Co. has been organized in Florida.

The Fort Scott & Wichita R. R. will be extended to McPherson.

The Nebraska, Garden City and Southwestern Railroad has been incorporated in Kansas.

The Augusta & Newberry (S. C.) R. R. is to be commenced at once.

The Fergus Falls, Morris & Appleton R. R. has been organized in Minnesota, to give Fergus Falls direct communication with Chicago, via the C. M. & St. P. R. R. A survey has been made.

Augusta, Gibson & Sandersville R. R.—The work of extending the road to Sandersville, Ga., is to be pushed forward. The entire length of 70 miles is expected to be completed in a few months.

The Minneapolis and Champlain R. R. has been incorporated to construct and operate a railroad from Minneapolis to the village of Champlain. President, George Brackett; Vice President, H. F. Brown; Secretary, George W. Marchant; Treasurer, J. W. Lawrence.

Ridgefield and New York R. R.—The directors have decided to commence work at once, and complete the first section of six miles, running through Pemberwick, Glenville, Round Hill, and Stanwich, and put it in operation as quickly as possible. This road will connect with the New York, New Haven and Hartford R. R. at Port Chester.

Kentucky Projects.—Bills have been introduced in the Kentucky Legislature incorporating the Lexington, Nicholasville & Whitesburg Railroad Co., the Frankfort, Bellepoint & Leetown Street Railway Co., the Falls City Street Railway Co., with A. Strauss, M. Schwartz and M. Muldoon as incorporators; and the Madison & Southern Railway Co.

Brockville & Westport (Ont.) R. R.—The company has put on two extra surveying parties in order to get the line located at once. Walter Ceatly and a staff of assistants were ordered last week to proceed to Marsh bridge, at the head of Graham Lake, to run a line through to Farmersville. The farmers in the vicinity are busy getting out ties and putting them on the survey.—Smith's Falls *Independent*.

The Manitoba R. R. Co. recently sent out a surveying party to run a line for a cut-off from Elk River through Princeton to Malacca, on the Hinckley branch. The company has made a proposition to the towns of Baldwin and Princeton, stating that it would build such a line, and have it in running order by Dec. 1, provided the first named town voted bonds in the sum of $2,700, and Mille Lacs county in the sum of $47,000.

Illinois Central R. R.—It is reported that the Yazoo City Extension is being rapidly pushed ahead, with the intention of completing it by the beginning of May. This extension is from Yazoo City to the Yalobusha City, a distance of seventy miles, with a branch to connect the extension with the West and East Railroad at Lexington, Miss. This brings the Illinois Central within ninety miles of Memphis, to which point it is expected to extend the line during the coming year.

Chesapeake and Nashville R. R.—Robert Mich has been appointed Superintendent of the Chesapeake and Nashville R. R., with headquarters at Gallatin. The company will begin laying track with 62 pound rails about April 1, from Gallatin to Scottsville; and as Capt. H. Sawyer has located to Glasgow, the line will be at once built to that point from Scottsville. The Knoxville and Nashville R. R., Major Blanchard, Chief Engineer, is locating from Carthage to Gallatin and expects to connect in about a month.

The Long Island City and Long Beach R. R. Co. has been incorporated in the County Clerk's office in Brooklyn. Capital stock, $1,900,000. The company proposes to build a surface railroad from Long Island City, through Brooklyn to Fort Hamilton, with a branch road from Flatbush to Canarsie. The length of the road is to be 19 miles. The seven directors for the first year, are: Rufus M. Williams, Thomas J. Powell and Charles A. Miller, of Brooklyn, and James E. M. Bowen, Austin Gallagher, Maximillian Calm and Isaac A. Josephi, of New York.

The Denver and New Orleans R. R., has been sold at auction at Denver under foreclosure of mortgage held by first mortgage bondholders. J. Sidney Brown, trustee for the Mercantile Trust Company, of Brooklyn, purchased the road for $3,117,358. It is understood tha the sale is a step in the reorganizing of the road under the name of the Denver, Texas and Gulf R. R. and will bring to an adjustment several negotiations for the extension of the road to a connection with the For Worth and Denver City R. R. at Cinnamon river, making a through line from Denver to New Orleans and Galveston.

The Montgomery & Florida R. R. has been chartered by M. P. Le Grand, J. R. Warren and others.

The Union Pacific R. R. Co. has sold 250,000 acres of land lying between North Platte and Ogalalla to the Bay State Cattle Co.

The Long Island R. R. is to be extended from its present terminus at Whitestone, a mile to the shore of the bay.

The Arizona Mineral Belt Railroad from Flagstaff, on the Atlantic and Pacific R. R. to Globe, A. T., is to be begun shortly.

The Eastern Railroad Company has petitioned the railroad commissioners for leave to build an extension of the road from West Lynn, Mass., to Peabody.

The Erie Railroad is to be ballasted with stone its entire length. The work will be commenced this summer.

Palace Street Cars.—A company has been incorporated to manufacture and operate palace cars in connection with the street railways of Chicago. Capital stock, $500,000.

A New Railroad.—About $40,000 has already been secured, and a company will at once be organized to construct a railroad from Lima to Rush Junction, N. Y. Prof. Phelps, of Lima, is interested.

Omaha Cable R. R.—Work is about to commence at Omaha, Neb., on a cable railway, with the intention of completing four miles of double track by November at a cost of $250,000.

The Pilot Point & Western R. R. Co. has been incorporated to build from McKinney to Gainesville, Tex. Capital stock, $500,000. Incorporators, W. A. Rhea, W. A. Kendal and others.

Mixed Gauge in the West.—By agreement with the Union Pacific R. R. the roadbed and bridges of the Utah and Northern Narrow Gauge R. R. are to be widened so as to permit the laying of a third rail to make a standard gauge for the Northern Pacific R. R. to connect the latter's main line with Butte, M. T.

Bridges Authorized.—The Senate has passed bills granting the Astoria and Winnemucca Railroad Company the right to construct bridges over navigable water-courses, and authorizing the Bellingham Bay Railway and Navigation Company to build certain bridges in Washington Territory.

The Jersey Railroad Construction Co. has been incorporated by Frederick Day, of Elizabeth; Charles D. Ridgway, of Jersey City, and Lewis R. Pomroy, of Chatham. Capital stock, $100,000. It is thought by some to be a scheme for the construction of a road from Bound Brook through Newark by the Baltimore & Ohio R. R.

The Fairchild & Mississippi R. R. has been incorporated. Capital, $1,000,000. The road is to run from Fairchild, Wis., southwest to the Mississippi, intersecting the Burlington & Northern R. R., and northeast from Fairchild, intersecting the Wisconsin Central R. R. near Abbotsford. Work will be begun this summer on the line between Fairchild and Abbotsford.

The New York, Bloosmburg & Western R. R. has been incorporated to build from Mauch Chunk to New Castle, Pa., a distance of 280 miles. Capital stock, $10,000,000. The directors are W. W. Trask, Newburg, N. Y.; D. Messmore, New York; John A. Blair, New Jersey; David Lowenburg, J. C. Brown, A. Z. Schoch and E. C. Wells, of Bloomsburg.

Chicago, Burlington & Northern R. R.—The work on the massive stone piers of the bridge across the Wisconsin river at Prairie du Chien, is completed. The trestle-work across the river bottom is nearly completed, and the iron bridge will be put up at once. Track is being laid at Savanna, Ill., at the rate of a mile a day by the use of a track-laying and ballasting machine.

The Parsons, Girard & Arcadia R. R. has been chartered. The road will run from Parsons, Kan., to Girard and Arcadia, Kan., and then in a northeasterly direction to the Missouri river. The directors are Angell Matthewson, F. H. Snyder, S. M. Cambern, W. B. Matthewson and G. W. Thornton, of Parsons; Wm. H. Taylor, of New York; John Foutz and Lauren Brown, of Girard, and J. L. Jewett, of Arcadia.

The St. Louis & San Francisco Railroad.—Messrs. Scott & Sons, contractors for the grade work on the ten-mile extension, west of Red Fork, I. T., are shipping all their teams across the Arkansas river to Tulsa. From there they go across the country to work on the extension from Coffeyville, Kan. No work will be done in extending the line from Red Fork until the fall. The company has been granted an extension of time of one year for the completion of the road through the Choctaw and Chicasaw nations' lands.

A New Minnesota Railroad.—A corps of engineers, in charge of Engineer Hoffman, is surveying a railroad from Minneapolis to Buffalo and Fairhaven, and on through to some point in the northern part of the state.

The Delaware and Hudson Canal Company proposes to tunnel through the buildings on Broadway, Albany, from near the foot of Hamilton street to a point nearly opposite Pruyn street, and lay a single track.

Convict Labor.—The House of Representatives at Washington has passed a bill making it a misdemeanor to hire or contract out the labor of United States prisoners. There were only eight votes in the negative.

Mississippi Projects.—Bills have been introduced in the Mississippi legislature to incorporate the Hill City Street Railroad Co., and the Vicksburg, Yazoo, Delta & Northwestern Railway Co.

A Paris Underground Railroad.—Paris is to have a metropolitan underground railroad. The Minister of Public Works has decided that it is to be constructed according to the plan of M. Paul Haag, an engineer of the Ponts-et Chaussées.

The Columbus & Northwestern Railroad has been incorporated in Nebraska by D. C. Kavanaugh, C. A. Newman and others. It is to run from Leigh to Columbus, thus connecting the latter city with the Chicago and Northwestern Railroad.

The Chicago, St. Louis & Pittsburg Railroad proposes to construct a road from Richmond to Cincinnati, via Hamilton. The surveys are about completed, and the right of way nearly secured. Cost estimated at $2,000,000.

The Staten Island Northern R. R. Co., with a capital stock of $1,900,000, has been incorporated. The road is to run from Port Richmond, on the North Shore, to Tottenville at the South end of the Island Its length will be about nineteen miles.

Denver and Rio Grande R. R.—It is reported that a settlement between the Denver & Rio Grande R. R., and the Denver & Rio Grande Western R. R. is practically consummated. Each road in future will be operated independently of, and in harmony with the other.

The Chicago & Northwestern R. R. Co. has decided to build its new line from Anamosa, Io., west to Gladbrook, with the view of taking the most favorable route to the latter point. Work will begin on the grade as soon as the frost is out of the ground. The companys surveyor's are running a line from Negaunee to Marquette, Mich.

Rails.—An order for 5,000 tons of rails for the Manitoba & Northwestern Railway Company has been placed at the Barrow (England) Rail Works, and inquiries are being made for 10,000 tons of rails for the Quebec & Lake St. John's Railway, and for 2,500 tons for the Quebec & Montmorenci Railway Company, which, if placed, will also, it is believed, go to the Barrow Works.

The Delaware River & Lancaster Railroad Company has brought suit against parties in Chester county, Pa., to recover subscriptions to stock. The defendants, with others, after paying their instalments of 10 per cent. refused to pay the balance of their subscriptions on the ground that they did not believe the road would ever be built. The line, which is as yet only on paper, is to run from Phœnixville to Lancaster.

CONTRACTING.

The Atchison, Topeka & Santa Fe R. R. will soon begin the construction of a line to connect with its Sonora division. The proposed route is via Tombstone, thence northwesterly to Tucson, Florence and Phœnix, A. T., after which it will connect with the Atlantic & Pacific. Surveys are being made north from Sherman, Tex., to the Red river to meet the line being run through the Indian Territory from Caldwell, Kan.

Ironwork for Gate.—Col. Wm. P. Craighill, U. S. Engineer, has awarded to Ainslie, Cochran & Co., of Louisville, the contract for iron for gate No. 6, of the Great Kanawha river, W. Va. They are to supply 45,000 pounds wrought-iron at five cents a pound; 29,000 pounds cast-iron at four cents, and 2,000 pounds steel at twelve and one-fourth cents. The firm were the lowest bidders.

A Sink Hole.—LAKE CITY, Minn., March 17.—One hundred and twenty-five men are employed on the Maiden Rock section of the Chicago, Burlington and Northern Railroad. This force, operating fifty dumpcars, is engaged in filling a sink hole, situated where the road crosses a bog near Maiden Rock bluff. An immense amount of material has been put into the hole, and many times what seemed to be a good road-bed has been made there, which the next morning was out of sight. The contractor hopes to ascertain the capacity of that sink hole before he is completely bankrupted.

Electric Street Railroad.—The Vandepoele electric street car system will go into operation shortly at Montgomery, Ala.

Hudson River Tunnel.—The Hudson River Tunnel is being pumped out after being filled with water for two years. The announced purpose is to exhibit the work to capitalists to interest them in the completion of the tunnel. Col. Haskins announces that the structure is uninjured.

Cable Grips.—The Stewart & Vernow Machine Company are building twenty grips of the Nelson & Judge pattern for the St. Louis cable street railway. These grips have the toggle-joint movement, and weigh 344 pounds each. They were patented last November, and are accounted remarkably light in comparison with other grips. When in use the cable runs over two small sheaves attached to the lower end of the grip, and is operated upon by downward pressure from a hand lever extending through the slot to the car above.

Contract Withdrawn.—The Brandywine Granite Co., whose bid for supplying stone for the gate house, Croton Aqueduct, was the lowest, has withdrawn its bid, giving as the reason that it could not anticipate the action of the Knights of Labor, and was consequently unwilling to take any risks. By the terms of the bid the contract would have amounted to about $100,000, of which over $50,000 would have been paid to the laborers; $40,000 to the stonecutters and over $10,000 for other work, such as quarrying and other handling of the stone.

The Neuchatel Asphalt Co. has just completed the laying of the floors in the new Grand Central Depot. The area covered was 45,000 square feet, including the floors of the waiting and baggage rooms, cellar and platforms. The floor of the baggage room in the old depot has also been laid with Val de Travers rock asphalt, experience having proved that it was eminently fitted for the hard usage to which floors are subjected. The same company has also just finished laying the roof and floors, 57,000 square feet, of the newly built De Vinne Press Building, Fourth street and Lafayette place.

Fast Pile Driving.—PRAIRIE DU CHIEN, WIS., March 16.—The *Courier* tells the following pile driving story: On Tuesday Mr. J. F. Hanscom, contractor on the Wisconsin river bottoms for the C. B. & N. R. R. performed the greatest feat of pile driving that has ever come under our notice. In nine hours with one of his lightning pile drivers he drove down 100 oak piles, that measured 16 inches at the butt end, and were 23 to 25 feet long, penetrating an average of 20 feet. The average strike of the hammer was forty blows to the pile, and the distance from starting point was 400 feet over the bottom land.

Street Dirt Contract.—The following bids have been received for removing the street dirt at Albany in the five police precincts for the ensuing year, the bids giving the price for each team, including man, broom and shovel, per day.

First Precinct.

Patrick H. Reilly	$6.00
Bridget Mead	5.25
Thomas Lynch	5.75
Wm. Muckle	4.45

Contract awarded to Wm. Muckle.

Second Precinct.

Patrick H. Reilly	$6.00
Bridget Mead (informal)	4.75
Thomas Lynch	5.75
William Muckle	4.45
Ezra Bush (informal)	5.65
John Kelly	5.25

Contract awarded to Wm. Muckle.

Third Precinct.

Patrick H. Reilly	$6.00
Bridget Mead (informal)	4.75
Thomas Lynch	5.75
William Muckle	4.45
Ezra Bush (informal)	5.65
John Kelly	5.25

Informalities being found in both the bids of Muckle and Kelley, they were thrown out and the work for this district ordered readvertized.

Fourth Precinct.

Patrick H. Reilly	$6.00
William Muckle	4.45
Ezra Bush	4.65

Contract awarded to Wm. Muckle.

Fifth Precinct.

Patrick H. Reilly	$6.00
William Muckle	4.45
Ezra Bush	4.65

Contract awarded to Wm. Muckle.

Brick, Sand, Cement.—Bids for supplying brick, cement and sand for the State, War and Navy Department building were as follows: Brick, Washington Brick Machine Company, $7.37 per 1,000; A. Richards & Co., $7.80; Natural cement, James H. McGill, $1.11 per barrel; J. G. & J. N. Waters, $1.15 and $1.24; H. L. Cranford, $1.25; and J. M. Wheatley, $1.14 and $1.23. Portland cement, J. H. McGill, $2.79 per barrel; J. G. & J. N. Waters, $3.25 and H. L. Cranford, $3.10. Sand, R. M. Miller, .93 per cubic yard; Thomas M. Milstead, .94, and J. B. Lord, $1.03. The awards will not be made until after the materials furnished are tested.

Denver City Regulations.—By recently passed aldermanic bills it is provided that the best flagging stone must be used within the central portion of the city; in front of business houses, not less than twelve feet wide, and in front of residence property, not less than five feet wide, and shall present a smooth and unbroken surface. In the suburbs a walk of plank boards, two inches thick, and laid on 6x4 scantlings of hard wood, is provided for. The City Engineer shall make the necessary grades and shall have supervision of the work. Common brick are to be 8 1-4 inches long, 4 1-16 inches wide and 2 3-8 inches thick. All stock brick are to be the same as the common brick, except that they shall be 2 3-8 inches thick.

Cleveland Belt Line Bridge.—Fourteen proposals for building the substructure of the belt line bridge were received by the Board of Improvements, Cleveland, O. The bids were as follows:

Stanley, Fisher & Co.	$233,277.50
J. S. Casement, R. Freeman and J. Le Duke	233,802.50
L. P. and J. A. Smith	247,225.00
C. J. Engel, James Nichol, and A. J. Christy	252,985.00
W. R. Thomas and James Phillips	277,475.00
A. F. Chapman, J. D. Casey, and W. H. Searles	281,795.00
James Hugel and A. G. Daykin	287,100.00
Luke Brennan	293,465.00
J. H. Drake and W. D. Stratton	296,800.00
R. G. Huston	302,775.00
G. W. and J. W. Harper	314,935.00
H. M. Clafien and J. C. Williams	321,552.50
A. H. Delameter	347,233.00
A. C. Goldsmith	359,325.00

The contract was awarded to Messrs. Stanley, Fisher & Co.

Bids for Paynesville and Grove bridges in Stearns Co., and Clearwater bridge between the counties of Stearns and Wright, (each span 144 feet) were received at St. Cloud, Minn., March 18th, as follows:

Name of Firm.	For Superstructure at Paynesville, Grove & Clearwater.	For Superstructure at Paynesville & Grove, & Iron Piers at Grove.
Shiffler Bridge Works	$8220.00	$6770.00
Smith Bridge Co	7788.00	6113.00
Milwaukee Bridge Co.	7091.00	5751.00
Chicago Bridge Co.	6699.00	5224.00
King Bridge Co	6980.00	5380.00
Penn. Bridge Co	6866.00	5258.00
Canton Bridge Co	6700.00	5150.00
Columbia Bridge Co.	6696.00	5136.00
B. F. Parkes	6596.00	5134.00
Groton Bridge Co	6487.00	Informal.

Contract awarded to Columbia Bridge Co. for Paynesville and Grove superstructures and iron cylinder piers at Grove.

Cobblestone Paving Prices.—The following bids have been received for grading and paving in Brooklyn. Forty-third street: Charles Hart, $5.65 per running foot; Patrick O'Hara, $5.54; John J. Hickey, $4.91; Richard Whelan, $4.49. Thirteenth street; John Morrissey, $7.75; P. O'Hara, $6.20; Charles Hart, $5.95; John J. Hickey, $5.49; James F. Gillen, $4.49. Margaretta street; James F. Gillen, $3.25; Charles Hart, $3.17; Wm. Mogk, $2.94; John Morrissey, $2.90.

Pipes, Castings, etc.—The Lancaster, Pa., Water Committee of City Councils has awarded the following contracts:

Digging and refilling trenches: Benjamin Clingman, 58½ cents for rock and 15½ for earth.

Street stop valves: John L. Arnold, 4-inch valves, $8.50; 6-inch valves, $13.25; 8-inch valves, $21.75; 12-inch valves, $39.50; 20-inch valves, $110.

Water Pipes: R. D. Wood & Co., of Philadelphia, 4-inch, per gross ton, $30.40; 6-inch, per gross ton, $29.70; 8-inch, per gross ton, $29.40; 12-inch, per gross ton, $28.40; 20-inch, per gross ton, $28.10.

Ferrules: J. J. Cochran, 64 cents each.

Fire Hydrants: Joseph H. Huber, $16 each.

Special Castings: R. C. McCulley, 2 cents per pound.

Plug Castings; Meilert Foundry and Machine Company, of Reading, $6 each.

Stop Boxes: William Wohlson, 3¼ cents per foot.

Coal for City Water Works: Baumgardners & Jeffries, $2.18.

Lead: John L. Arnold, 5¼ cents per pound.

Hauling Pipe: D. Trewitz, 40 cents per net ton.

Market Report of Engineering Materials.

New York March 25, 1886.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.			
Angles		2.00c	@ 2.10c
" steel		2.35	@ 2.45
Tees		2.35	@ 2.40
Beams and channels, American		3.0	@
Tank Plates		2.15	@ 2.20
Shell Plates		2.4	@ 2.5
Steel plates, Tank		2.5	
WROUGHT-IRON PIPE, PITTSBURGH.			
Butt welded, black	Discount	42½	@ 45
" " galvanized	"	32½	@ 35
Lap welded black	"	60	@ 62½
" galvanized	"	42½	@ 45
Boiler tubes	"	55	
RAILS.			
Steel (large lots at mill)		$34.00	@ $35.00
Old rails		20.00	@ 21.00
Old rails, steel		22.00	@ 23.00
R R. spikes		2.40c.	
R R. splice-plates		2.00	
R R. track bolts, square nuts		3.00	
Barb-wire fencing, galvanized			5.00
" painted			4.00
Corrugated Iron			
Nails			
Iron, per keg			2.45
Steel do.			2.60

METALS.

COPPER.		
Lake Superior	$11.45	@ 11.50
Other Brands		10.25
LEAD.		
Com. Domestic	4.90	
Lead Pipe	.06¼c.	
Tin-Lined Lead Pipe	.15	
Sheet Lead	.07¼	
ZINC.		
Sheet	$5.40	@ 5.60

BRICK.

Cargoes (afloat)		
Haverstraw per M.	8.25	@ 8 50
Fishkill		
Up-River		
Jerseys	7.00	@ 8.00
Long Island	8.00	@ 8.50
Pale	4.75	@ 5.00
FRONTS.		
Croton, red	11.00	@ 14.00
" dark	11.00	@ 14.00
" brown	10.00	@ 13.00
Philadelphia pressed	24.00	@ 25.00
Trenton "	24.00	@ 25.00
Baltimore "	37.00	@ 41.00
Buff "	33.00	@ 35.00
Enameled English	65.00	@ 130.00
" American	85.00	@ 120.00
Fire brick	24.50	@ 55.00

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be wholesale in New York, subject to such special rates as large quantities may warrant:

Alsen's Portland Cement Works	$2.50	@ $3.00
BAETJER & MEYERSTEIN:		
Hanover Portland	2.60	@ 2.65
BELLONI & Co.:		
Hemmoor "Crown" brand		2.50
JAMES BRAND:		
K. B. & S.	2.55	@ 3.00
BROOKS, SHOOBRIDGE & Co.	2.45	@ 2.60
HOWARD FLEMING:		
Gibbs' English Portland, 400 lbs.	2.65	@ 2.90
K. B. & S. " "	2.75	@ 2.95
Stettiner, German	2.65	@ 2.85
Lagerdorfer, "	2.45	@ 2.75
Fieve, A 1, Belgian	2.35	@ 2.50
Roman	2.75	@ 3.00
Keene's Coarse	4.75	@ 5.50
" Fine	7.75	@ 8.50
" Superfine	8.50	@ 10.00
FISHER, ERSKINE W.:		
Stettin (German) Portland Cement	$2.40	@ 2.75
GABRIEL & SCHALL:		
Vorwohler "Lion"	2.65	@ 3.10
HUDSON RIVER CEMENT Co. Rosendale		1. 0
JOHNSON & WILSON:		
Saylor's American Portland	2.15	@ 2.40
LESLEY & TRINKLE, Philadelphia, Pa.:		
"Giant" Portland	2.20	@ 2.40
Improved "Union"	1.25	@ 1.50
Union	1.10	@ 1.20
MARCIAL & Co.:		
J. B. White & Bros. Coarse	4.50	@ 5.00
" Fine	8.00	@ 10.00
" Portland	2,45	@ 2.85
NEW YORK CEMENT Co.:		
Rosendale		1.20
N. Y. & ROSENDALE CEMENT Co.:		
Rosendale, "Bridge" brand		1.10
SINCLAIR & BAUSON:		
K. B. & S.	2 35	@ 2.60
STANDARD CEMENT Co		
E. THIELE:		
Dyckerhoff	2.90	@ 3.25
UNITED STATES CEMENT Co.:		
Windsor	1.00	@ 1.10
Standard		1.15
Cahill's Portland	2.15	@ 2.40
UNION AKRON CEMENT Co.:		
Akron "Star" brand.		

ASPHALT.

ROCK.		
Prices range per ton	$15.00	@ 20.00
According to quantity or brand, and whether taken from vessel or store.		
PAVEMENT.		
Barber's Asphalt	$2.50	@ $3.50

LIME.

Rockland, common per bbl	1.00	
" finishing	1.20	
State, common	.90	
" finishing	1.10	
Kingston, ground	.95	@ 1.00
Add 25c. to above figures for yard rates.		

STONE.

Cargo rates at New York.

Amherst freestone, No. 1	per cub. ft.	0.95	@ 1.00
" " No. 2	"	0.75	@ 0.85
" " light drab	"	0.80	@ 0.95
Berlin " in rough	"	0.75	@ 1.00
Berea " "	"		
Brown stone, Portland, Ct.		1.00	@ 1.35
" Belleville, N. J.		1.00	@ 1.35
Granite, rough		0.45	@ 1.25
Common building stone per load		2.00	@ 3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.		0.40	@ 3.00

SLATE.

Purple roofing per square	6.00	@ 7.00
Green "	6.00	@ 7.00
Red "	15.00	
Black Penna. (at New York) "	4.50	@ 5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box	per M.	18.00	@ 20.00
" Choice	"	65.00	@ 70.00
Tally plank, 1¼ in. 10 in. dres'd.	each.	.44	@ .50
Tally boards, dressed com.	"	.28	@ .30
SPRUCE, Boards dressed	"	.25	@ .28
Plank, 1¼ in	"	.28	@ .30
" 2 in.	"	.38	@ .40
" 2 in. dressed	"	.43	@ .45
Timber	per M.	20.00	@ 22.00
HEMLOCK, Boards	each.	.18	@ .20
Joist, 2¼ × 4 to 4 × 6 in		.16	@ .44
OAK	per M.	55.00	@ 65.00
CYPRESS 1, 1¼, 2 and 2¼ in	"	35.00	@ 40.00
YELLOW PINE, Girders	"	25.00	@ 30.00
Dressed flooring	"	28.00	@ 35.00
SHINGLES, Extra shaved pine, 16in.	"		
" sawed 18 in.	"	5.75	@ 6.00
LATH, Cargo rate	"	2.30	@ 2.35

PAINT.

Lead, white, American dry	per lb	.04¼ @ .06
" in oil pure	"	.06¼
" English, B. B. in oil	"	.08¼ @ .08¾
" Red, American	"	.05¼ @ .05½
Litharge	"	.05 @ 05½
Venetian red, American	"	.01 @ .01¼
Indian red	"	.05 @ .10
Vermillion, American lead	"	.10½ @ .12½
Paris green	"	.15 @ .20
Umber, Amer. raw and powdered	per lb.	.01¾ @ .01¾
Drop black, Amer.	"	.07 @ .13
" Eng.	"	.11 @ .13
Chrome green	"	.05 @ 20
Oxide zinc, American	"	.03¼ @ .04
" French	"	.06 @ .08

Trade Notes.

THE Davis Mining Company, Rowe, Mass., propose the coming summer to build a narrow gauge railroad to their mines, a distance of four miles. Cost, $50,000.

IT is proposed to to move the court house from Mayaville to Jamestown, N. Y. C. R. Lockwood, L. B. Warner, J. T. Wilson, S. B. Broadhead and Erie L. Hall of Jamestown, have been appointed a committee to investigate the subject for a suitable site for the public buildings.

ANY one that would devise an accurate and compact machine for testing cements and other mortars for practical purposes, portable and durable, easily manipulated, would confer a boon upon engineers, architects and contractors. Most, if not all, of the machines in use are heavy, cumbersome and complicated, and cannot be used readily except for office work, and are too expensive for universal use.

A 400-ton steamer to ply between Tobasco and Vera Cruz has been launched at Dioloque's ship-yards, Camden, N. J.

THE Farrel Foundry and Machine Company, of Ansonia, has recently cast the largest and heaviest chilled iron rolls ever cast in this country. They are for Philadelphia parties and are to be used in the manufacture of linoleum. The weight is fifteen tons, diameter, 30 inches.

THE plans have been drawn for the new woolen mill which S. F. Cushman is going to build in place of the one recently burned at Monson. The new mill will be built of brick and the contract for the erection has been taken by the Flynt Building and Construction Company Palmer, Mass. Mr. Cushman went to Bridgeport, Conn., to see a mill which the Flynt Company recently built there.

WASHINGTON, March 13.—Secretary Whitney has received information from a firm at San Francisco that they are about to ship to him for exhibition at the navy yard a solid steel ingot 6 feet long, 3 feet wide and 10 inches thick. This is made, they say, in an open hearth furnace and hammered under an immense hammer. It is planned so as to show every inch of surface. It will be sent by rail. They explain to the Secretary that this all-hammered steel plate is exactly the same kind as that made by Schneider & Co., of Creusot, in Europe, for the Spezzia trials in Italy, where that armor proved the best. This firm repudiates the assertions that steel cannot be made in this country for the cruisers and for any purpose of equal quality to any made in Europe.

MR. CARNEGIE'S forthcoming book is said to be intended primarily for British readers, to open the eyes of the masses in the United Kingdom to the wonderful advancement—physical, moral, political and intellectual—of the United States during the last half century, an advancement either little understood or wilfully misrepresented in Europe.

HOPEFUL SIDE OF THE LABOR TROUBLES.

THE patrons of the "Record and Guide" belong almost exclusively to the classes which employ labor. Bankers, real estate owners, builders, dealers in material of all kinds, contractors and the like, do not, as a general thing, feel it to be their interest to advance wages, shorten hours of labor, or submit to the dictation of trades unions. There is no need, therefore, for us to present the stereotyped arguments against the demands made by the working people. Our readers know them by heart. A more profitable employment of our time would be to point out what possible advantages may finally result from the labor agitation which is now going on all over the country, and which is destined to seriously embarrass all who are engaged in supplying capital for productive enterprises.

In the first place, it is clear that the demand for shorter hours and higher wages is an evidence that the times are better, and the great business interests of the country are on a paying basis. The very general success which has so far attended the efforts of the laboring classes shows that prices are rising and production profitable. The workpeople have found it impossible to advance the general average of wages when the times were bad. The depressed industrial situation which followed the panic of 1873 completely disintegrated the trades union organizations. They went all to pieces in the fierce struggle for employment which followed that blow at the industries of the country.

As we have frequently pointed out in these columns, a general and large addition to the wages of labor, provided the state of trade warranted it, would advantage every material interest in the nation. The working class is the spending class. Not one in a hundred of the wage receivers save any portion of their income. It follows that an advance in wages means larger expenditures and a heavier consumption of food and goods. There are, say, 10,000,000 people who work for wages. An addition of $2 per week would involve the throwing of $20,000,000 per week or over $1,000,000,000 per annum into the channels of retail trade. This is a prodigious sum, and its disbursement would stimulate every industry in the country. Hence, while it is the interest of every individual employer to get his work done at the minimum rate of wages, it is to the advantage of the great body of the business community that the working people should be in receipt of a liberal compensation. The objection to the Chinaman as a laborer is that he spends nothing. He saves his money to take back with him to his own country, and hence not only the working people whom he underbids but the manufacturers of consumable goods are opposed to the presence of the heathen Chinee among us. Trades union interference is a serious annoyance to all employers of labor. It is exasperating for an outside committee to tell a "boss," who has his capital engaged in a business, what wages he should pay and under what rules his men shall work for him. But, setting this aside, the uniformity in wages and hours which results is a decided advantage to the best class of employers. Under the old system, when there was no restraint upon the selfishness of the "boss," the meanest, most unscrupulous, had the liberal and high-minded employers at their mercy. By cutting down wages, by long hours, by employing apprentices, the "snide" builder and the dishonest boss was enabled to demoralize the whole trade. Not so when all labor has been organized. The fair and high-minded employer gets his work done at the same price as his more unscrupulous rival in business. It is, indeed, a positive advantage to all the interests involved when the price of labor is as fixed and unalterable as that of the materials used in production. The rivals in business have an even start, and the best employer will naturally attract to his service the superior workmen.

Everything indicates an unusual ferment among the working classes this spring. Their success so far will embolden their fellows in every department of business to try and increase their compensation and secure better treatment. These demands will be resisted, as a matter of course, and there is every indication of trouble ahead. But never in the history of industries in this country have the laboring classes been so well organized as they are to-day. In the years which have past the larger portion of our artizans were unintelligent, for in their rank were found the foreigner and American who could not succeed in more profitable employments. The average American born citizen is a trader, a storekeeper, a speculator, or a politician, he does not take kindly to manual labor. But within the last forty years there has been a concentration of wealth going on, and large establishments have taken the place of hundreds of smaller stores and shops. In other words we have developed a very rich class at the expense of our middle class; the impoverished members of which have been forced down to the ranks of the laboring classes. It is these Americans, who in former years would have been storekeepers or small employers, who are now organizing the trades unions and the Knights of Labor. The training they have had in self-government is teaching them how to organize the masses of their fellow-workmen. It is very significant when so rude a class as the car-drivers and conductors submit so readily to discipline, as was shown by the recent successful strike.

Certain alarmist writers are disposed to prophecy a dismal future for the country, because of the manifest power of such organizations as the Knights of Labor; but it would be well for capitalists to look on the bright side of things. After all, public opinion is supreme; and from it there is no appeal. The community upheld the car-drivers when they asked that their labor be limited to twelve hours, and that their pay be two dollars a day. This was a reasonable claim; but should any labor union make an extravagant demand it will not be acceded to. Common sense and a disposition to be fair will finally settle all disputes. In view of the prosperous condition of the building trade, the working people it employs may perchance demand better terms later on in the season. It would be well for contractors to be on their guard. They should allow themselves a liberal return for their work, and not put in very close estimates. Employers should see to it that they are well compensated for their work, and should provide in their contracts for possible advances in the rate of wages.—"Record and Guide.